Kardan University
BCS Faculty
Data Comm. and Networks

Outline

- What is standard?
- Why layered structure?
- OSI Model
  - Application Layer
  - Presentation Layer
  - Session Layer
  - Transport Layer
  - Network Layer
  - Data Link Layer
  - Physical Layer

Standard

- A standard provides a model for development that makes it possible for products to work regardless of the individual manufacturer.
- The primary reason for standards is to ensure that hardware and software produced by different vendors can work together.
- Guaranteeing National/International Interoperability.

Need for a Standard

- In 1980s, it was difficult for networks that used different specifications and implementations to exchange information.
- The same problem occurred with the companies that developed private or proprietary networking technologies. Proprietary means that one or a small group of companies controls all usage of the technology.
- The OSI model was developed by the International Standards Organization in the early 1980's. It describes the principles for interconnection of computer systems in an Open System Interconnection environment.

Need for a Standard

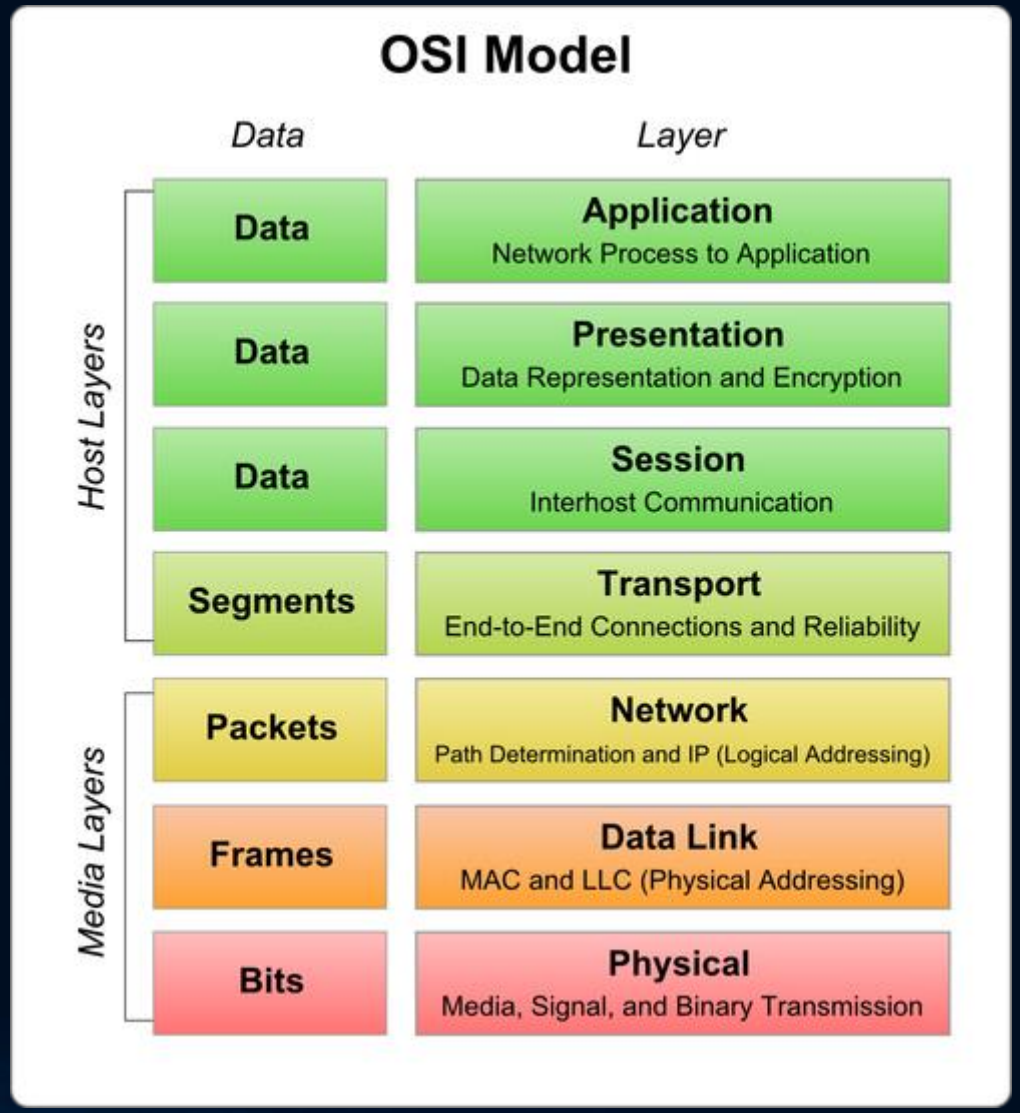
- OSI Model provided vendors with a set of standards that ensured greater compatibility and interoperability among various network technologies produced by companies around the world.
- OSI stands for (Open System Interconnect)
- OSI model is designed in a layered structure containing 7 independent layers.
- The layers are numbered from down to up.

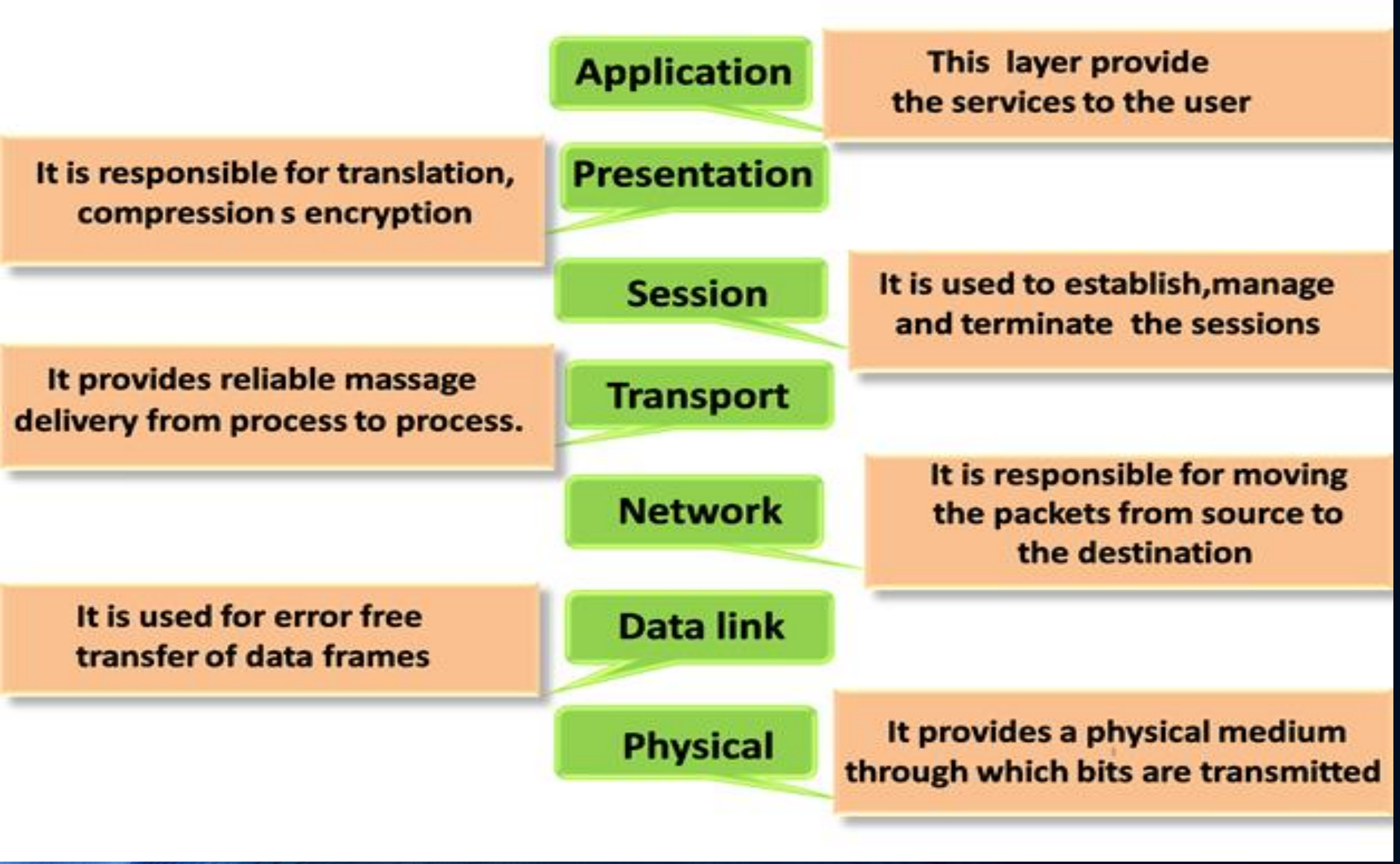
Why Layered Structure

- It breaks network communication into smaller, more manageable parts.
- It prevents changes in one layer from affecting other layers.
- It divides network communication into smaller parts to make learning it easier to understand

7 Layers of OSI Model

- Layer 7: Application
- Layer 6: Presentation
- Layer 5: Session
- Layer 4: Transport
- Layer 3: Network
- Layer 2: Data link
- Layer 1: Physical




Application
This layer provide the services to the user
It is responsible for translation, compression s encryption
Presentation
Session
It is used to establish,manage and terminate the sessions
It provides reliable massage delivery from process to process.
Transport
Network
It is responsible for moving the packets from source to the destination
It is used for error free transfer of data frames
Data link
Physical
It provides a physical medium through which bits are transmitted

Application layer (layer 7)

- Provides services to the applications and users.
- It provides an interface for the user to interact with the system.
- Whenever the user elects to read messages, transfer files or perform other network-related activities. Web browsers and other internet-connected apps, such as Outlook and Skype, use Layer 7 application protocols.
- Examples:
  - Email
  - File transfer
  - Database access

Application	• Provides a user interface
Presentation	• Presents data • Handles processing such as encryption
Session	• Keeps different applications' data separate

Presentation layer (layer 6)

- Data presentation
  - Translates or formats data for the application layer based on the semantics or syntax that the application accepts.
- Handles the data encryption, decryption, compression and decompression operations for application layer.
- Encryption is the process of converting data into some unreadable form.
- The receiving end must decrypt the data
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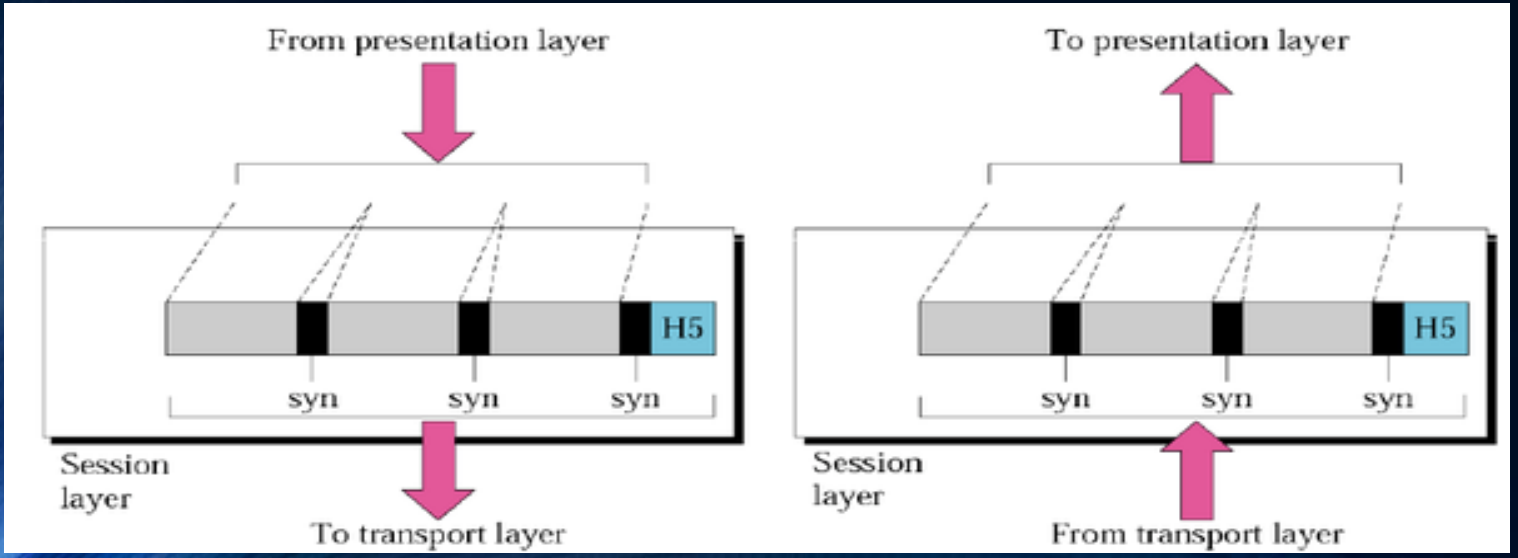
Session layer (layer 5)

- Establishes, manages, and terminates sessions between applications
- Its services include authentication and reconnection after an interruption.
- Keeps the data of different applications separate.

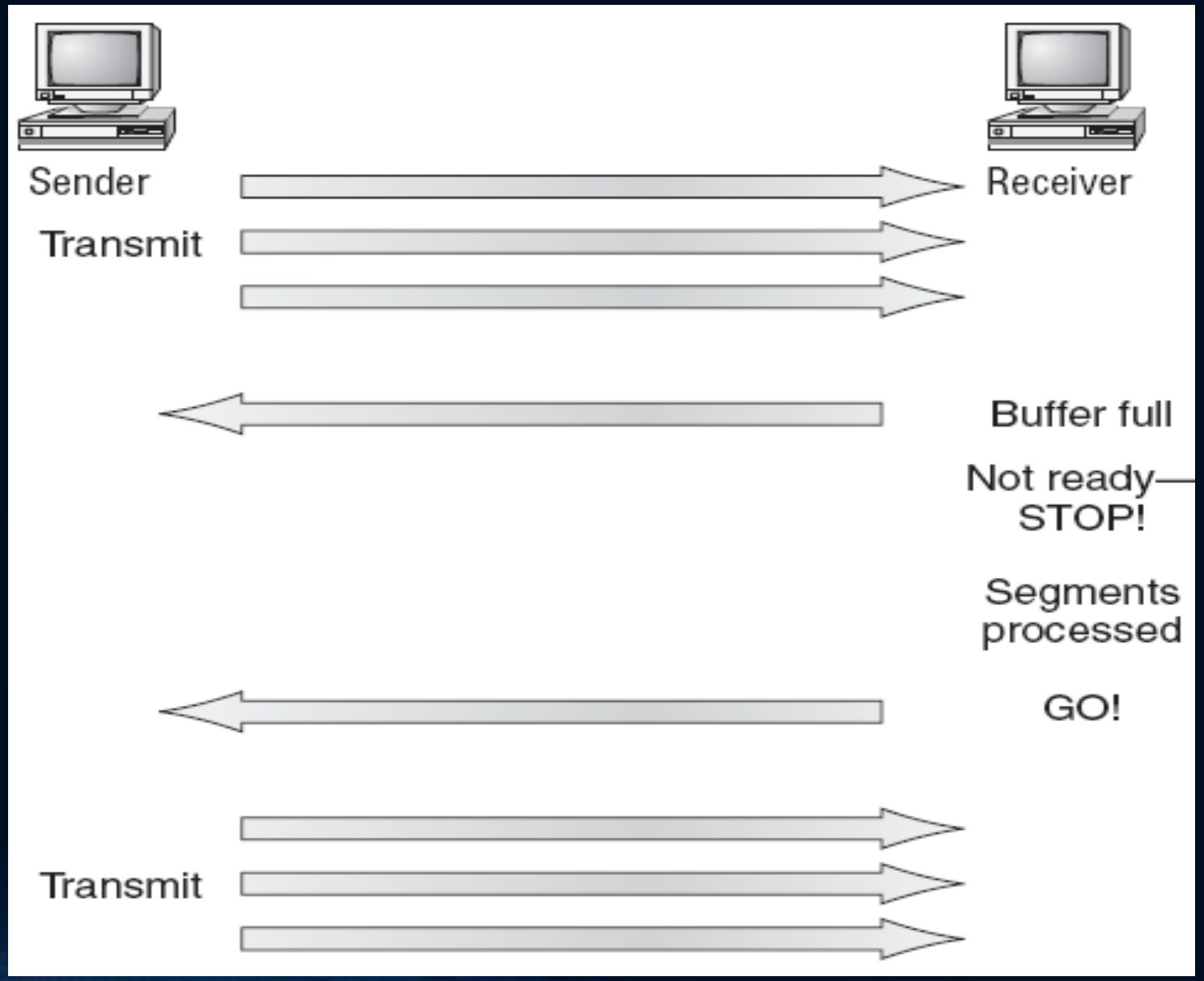


Transport layer (layer 4)

- End to end data delivery (responsible for data delivery from source to destination)
- Responsible for flow control and data recovery
- Subdivides data into small units called segments + port numbering
- The Transport layer main protocols are:
  - TCP (Transmission Control Protocol) connection-oriented/reliable
  - UDP (Users Datagram Protocol) connectionless or unreliable
- TCP supports Flow Control, Virtual Circuit, Windowing, sequencing and acknowledgement but UDP does not.

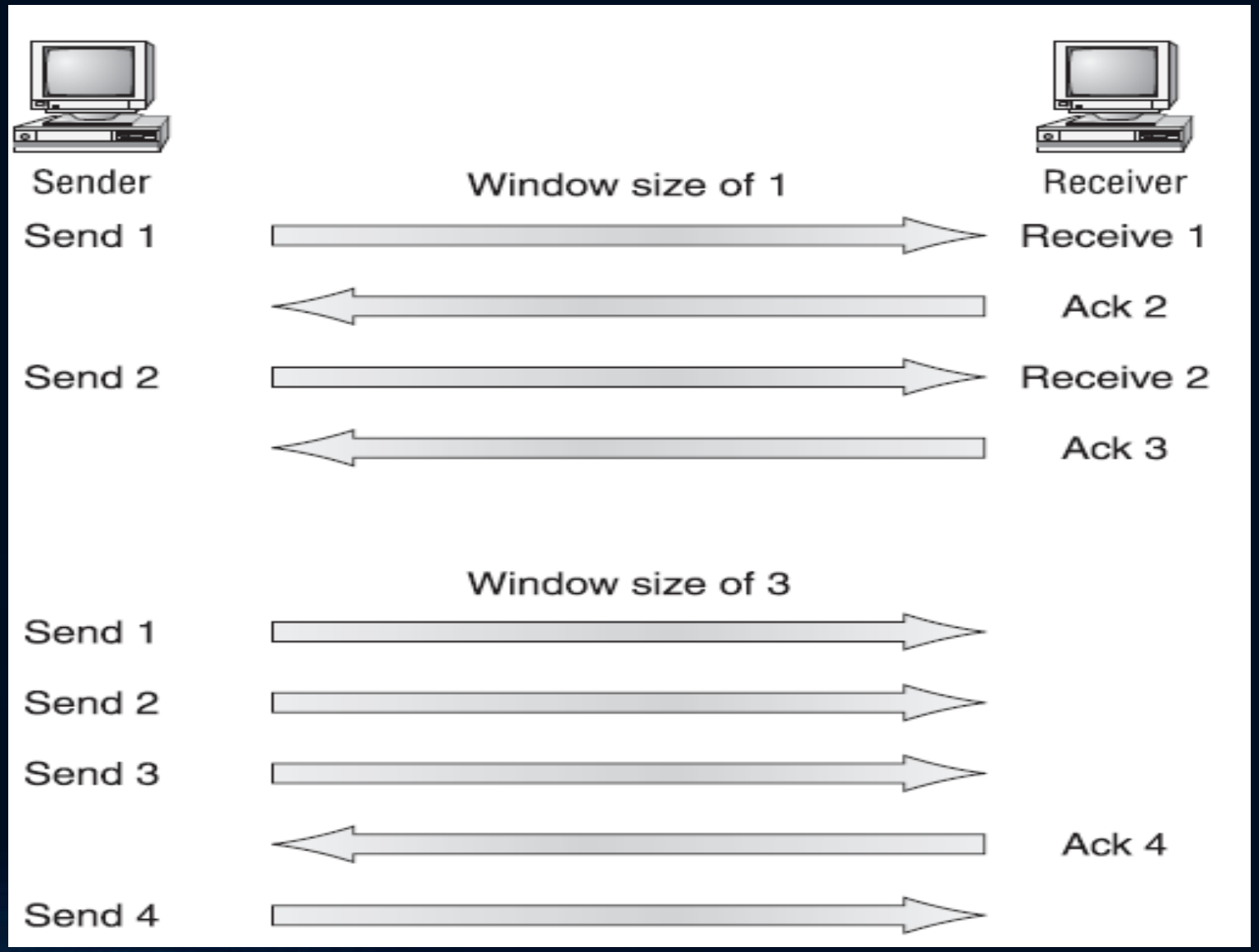
Flow control

- All the segments are acknowledged by the receiver
- Any segment not acknowledged will be retransmitted



Windowing

- The quantity of data that the sender can transfer without receiving acknowledge--ment is called window.

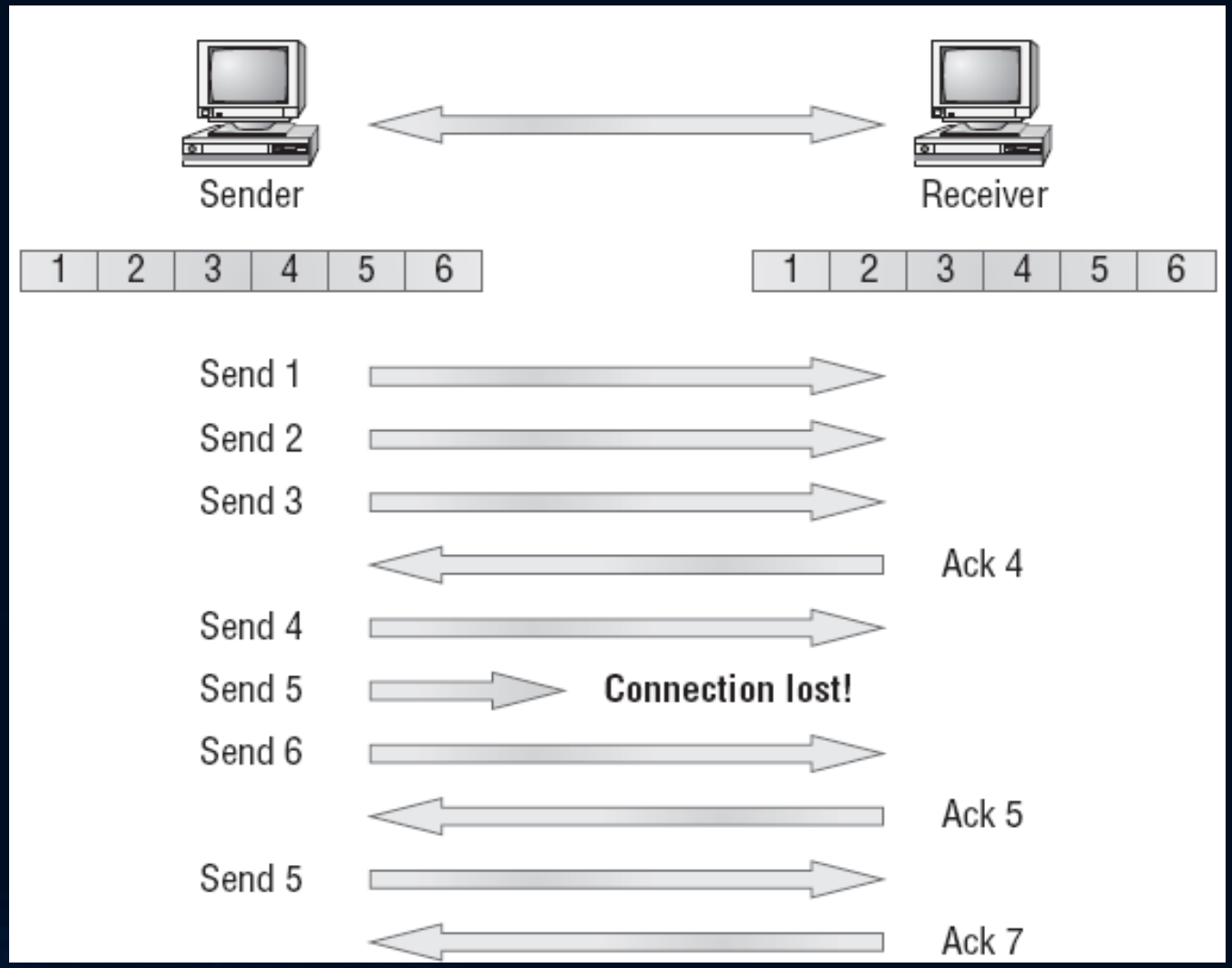


Sequencing

- Segments are sequenced back into their proper order upon arrival at their destination.

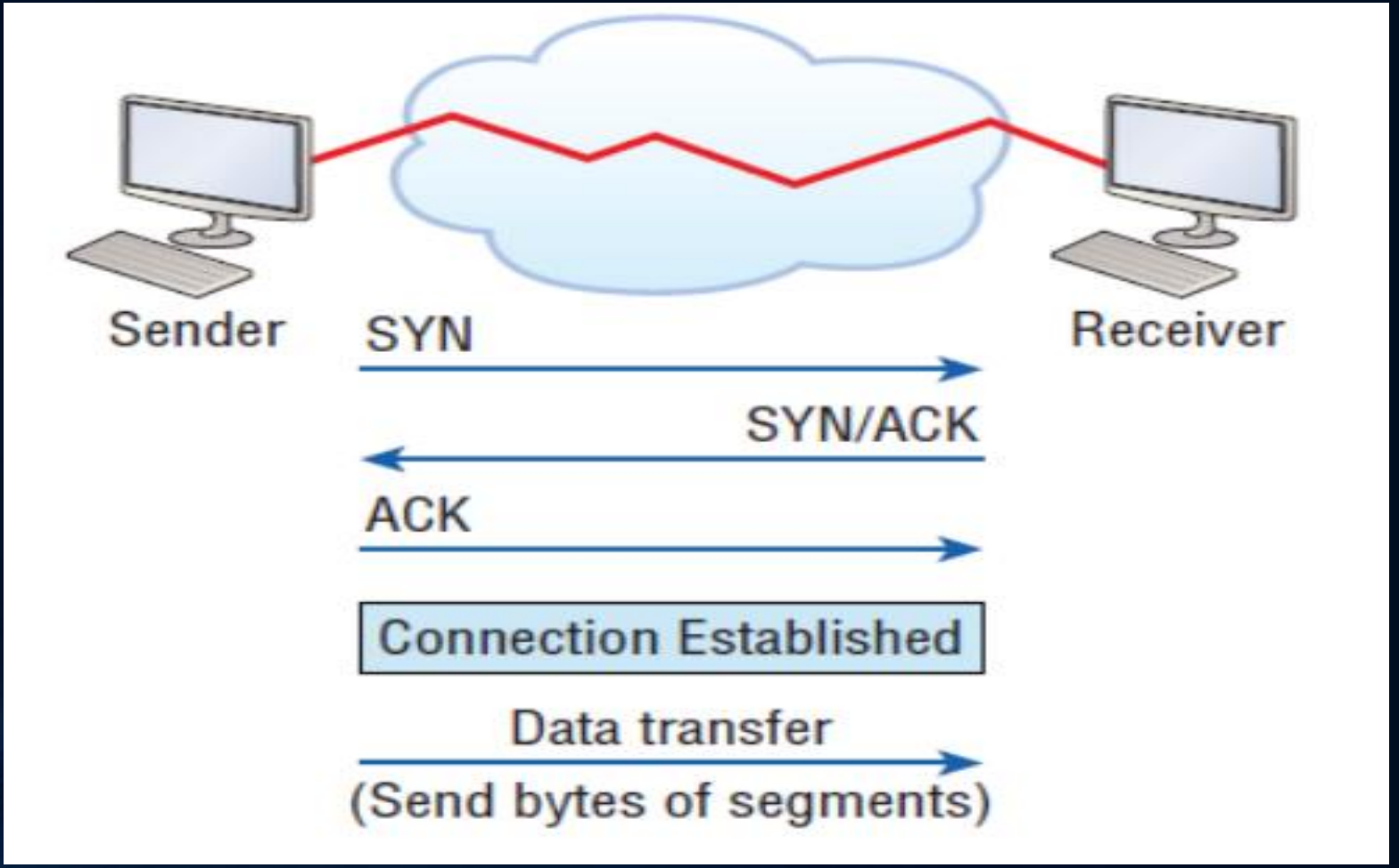
Acknowledgement

- The segments delivered are acknowledged back to the sender upon their reception.
- Sender starts timer when it sends data, if the timer expires before it receives any acknowledgement then the data is retransmitted



Virtual circuit

- Also called three-way handshake



Network layer (layer 3)

- Adds the source & destination IP into the IP header of each packet.
- Responsible for path determination and selection
- Subdivides segments into smaller units called packets
- Routers are

Network layer

devices

Transport	• Provides reliable or unreliable delivery • Performs error correction before retransmit
Network	• Provides logical addressing, which routers use for path determination
Data Link	• Combines packets into bytes and bytes into frames • Provides access to media using MAC address • Performs error detection not correction
Physical	• Moves bits between devices • Specifies voltage, wire speed, and pinout of cables

Data link layer (Layer 2)

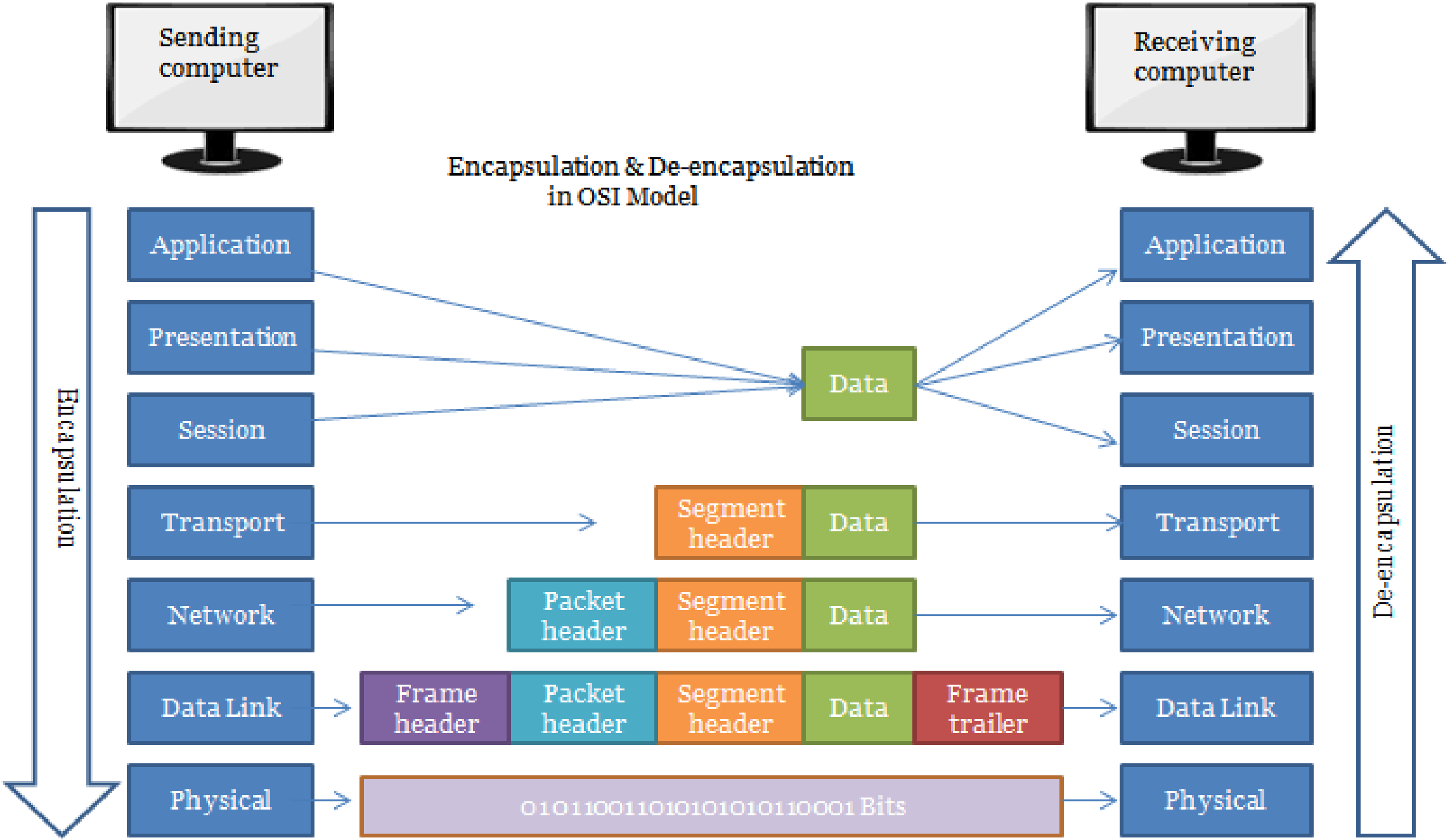
- Subdivides packets into smaller data units called frames
- Add source and destination MAC address to each frame.
- Switch is a data link layer device, because switches filter data based on MAC address.
- Responsible for node to node data delivery
- Error detection

Physical layer (layer 1)

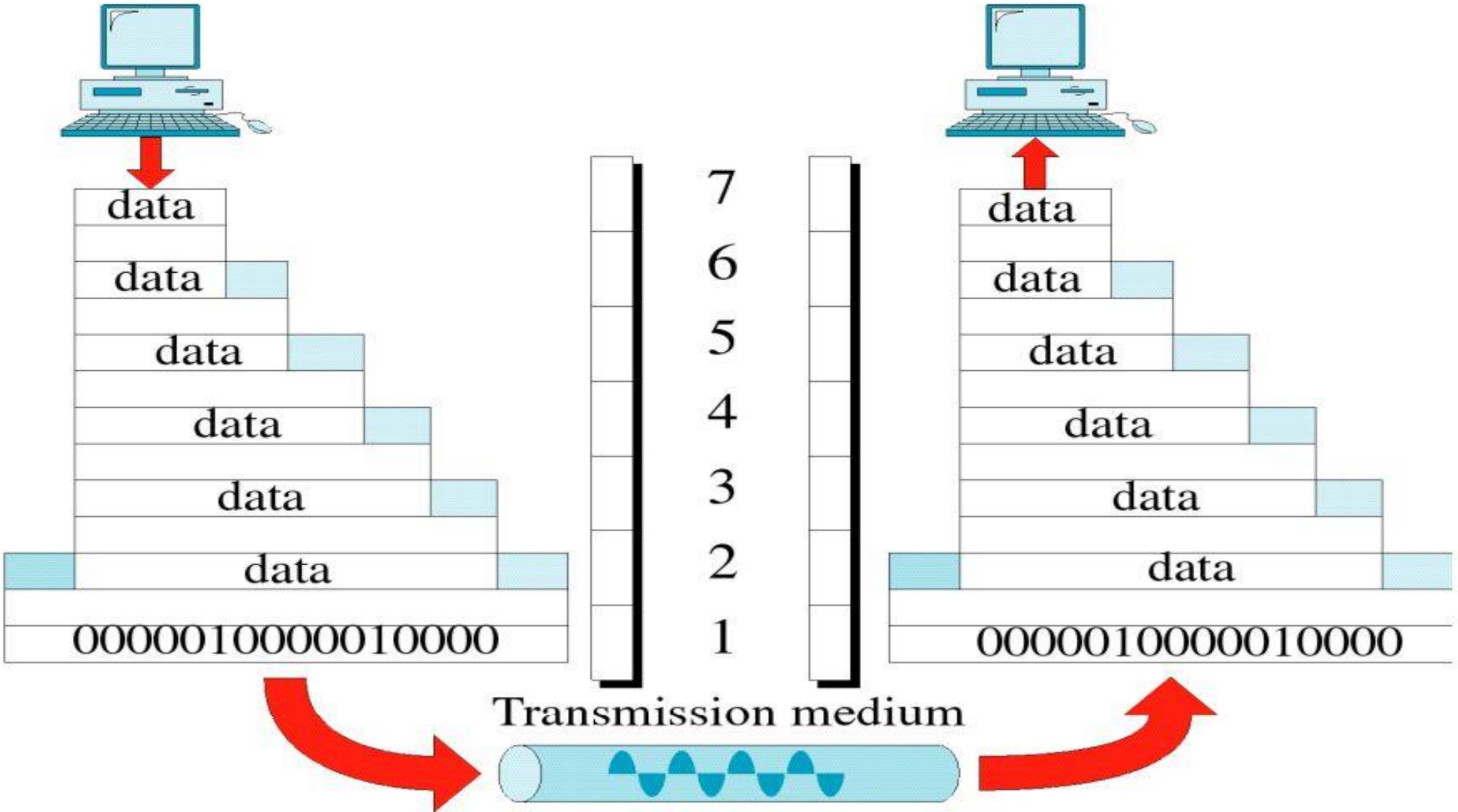
- Converts frames into binary data and binary data into signal when the data leave the sender machine.
- Responsible for identification of wires, connectors, voltage and data rate of the media.
- Its an interface with the actual physical media.
- Hub is a physical layer device.
- The type of media and topology is also identified by the physical layer.

Note

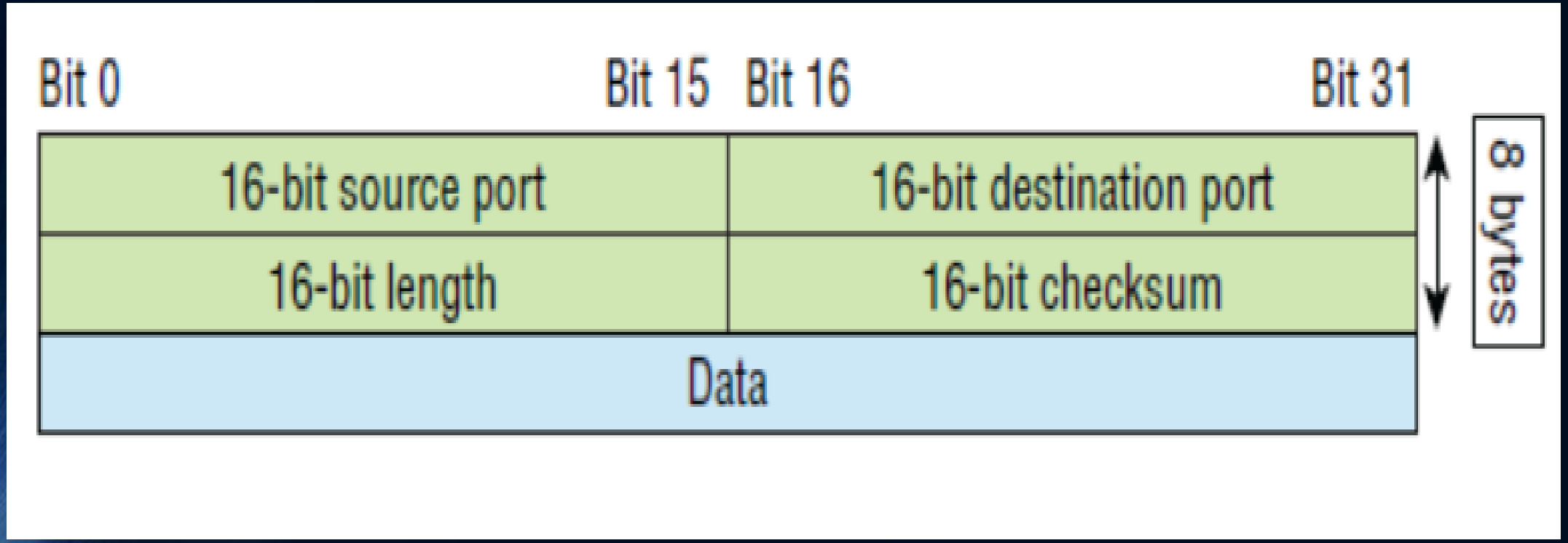
- While data is being sent in consideration to OSI Model, all layers except layer 1 and layer 7 adds some additional information to each data unit called header.
- Data link layer is the only layer which add header to each frame as well as a trailer
- The process of dividing data=>segments=>packets=>frames=> binary data=> signal is called encapsulation process.
- The reverse of encapsulation process at the receiving end is called de-encapsulation process.


Sending computer
Receiving computer
Encapsulation & De-encapsulation in OSI Model
Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Segment header
Data
Packet header
Segment header
Data
Frame header
Packet header
Segment header
Data
Frame trailer
0101100110101010101100001 Bits
Application
Presentation
Session
Transport
Network
Data Link
Physical
Encapsulation
De-encapsulation

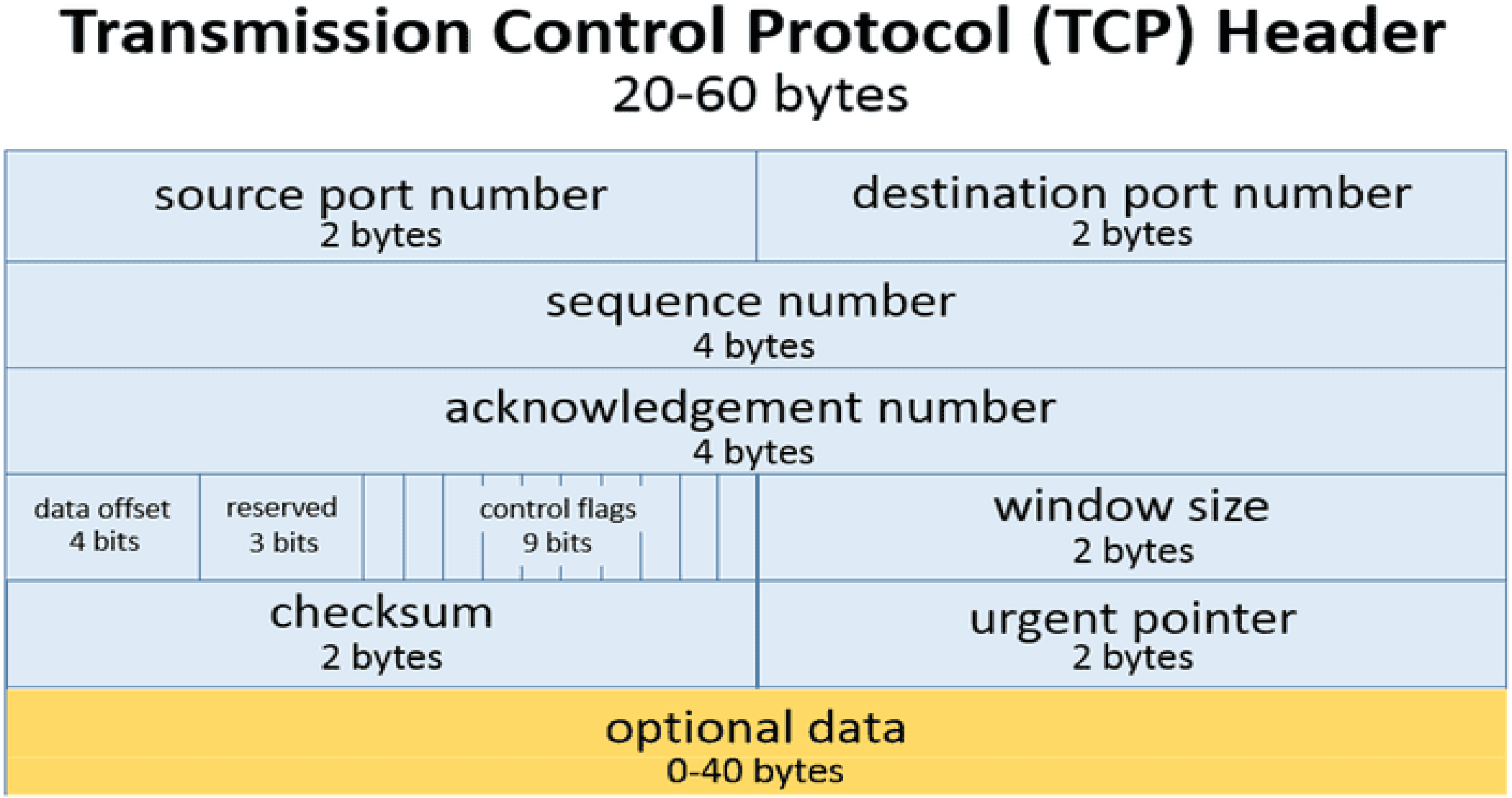
Exchange Using the OSI Model
Header & Trailer being added & removed



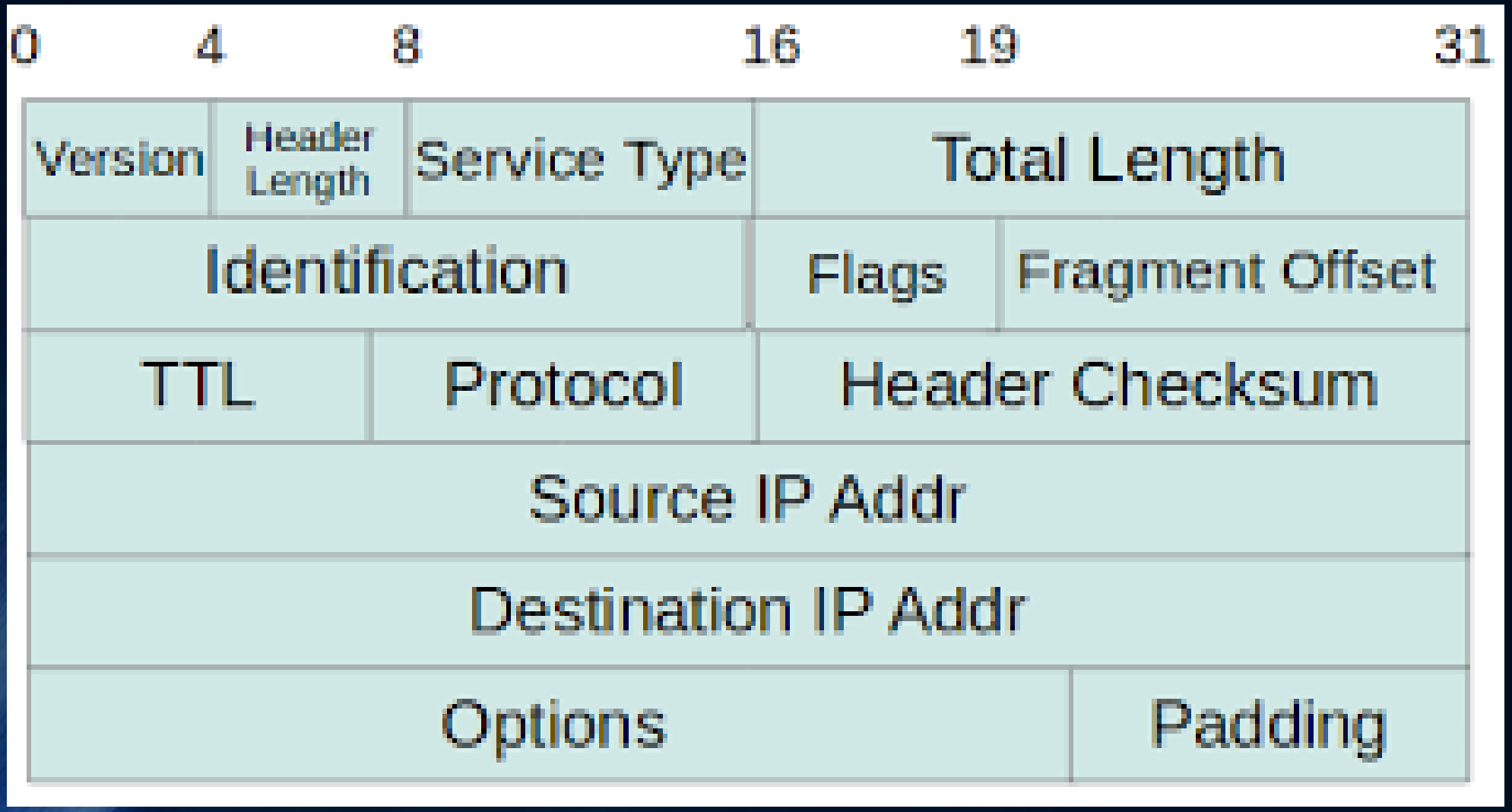
UDP Header format



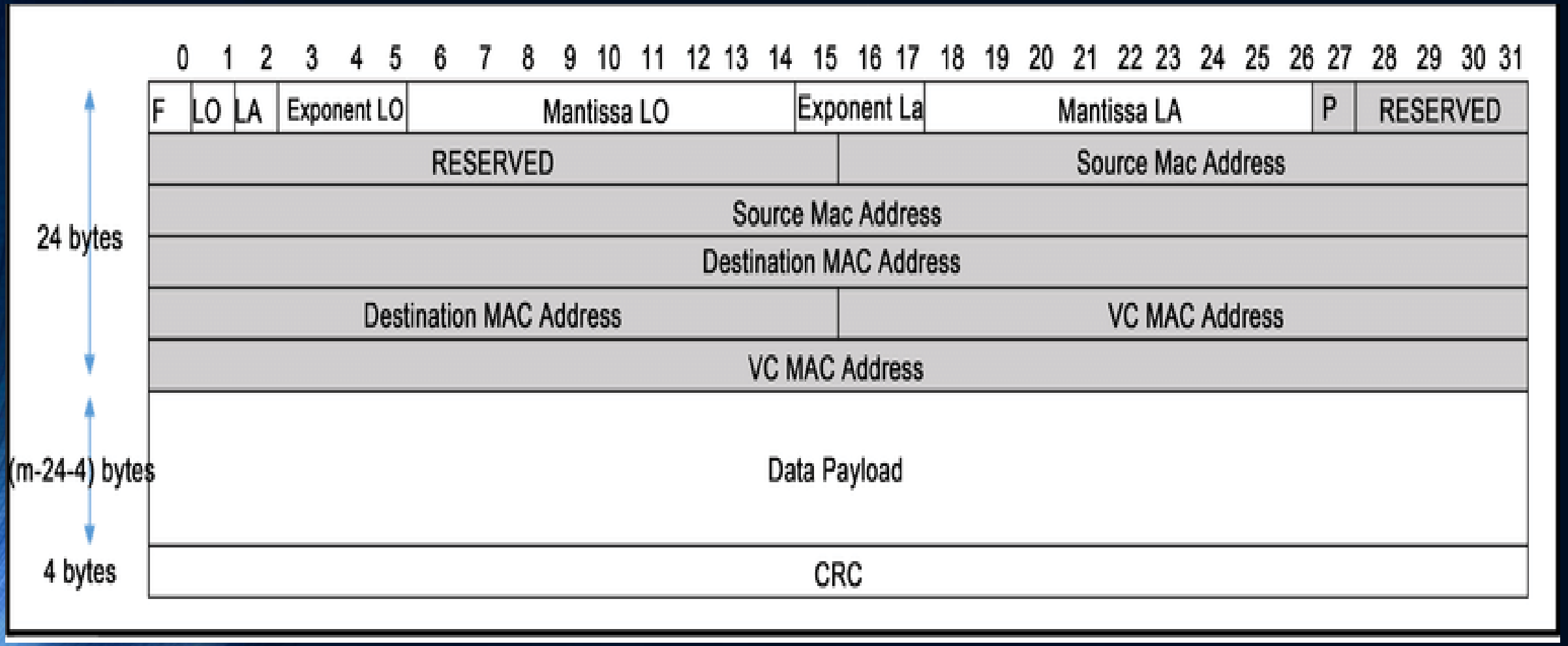
TCP Header format



IP header format



MAC header format



References

- https://study-ccna.com/ports-explained/
- Chapter 01 & 02 of Cisco CCNA book: CCNA Routing and Switching Study Guide - Lammle, Todd

MEMORIZE THIS

- ALL
- PEOPLE
- SEEMS
- TO
- NEED
- DATA
- PROCESS

THANK YOU