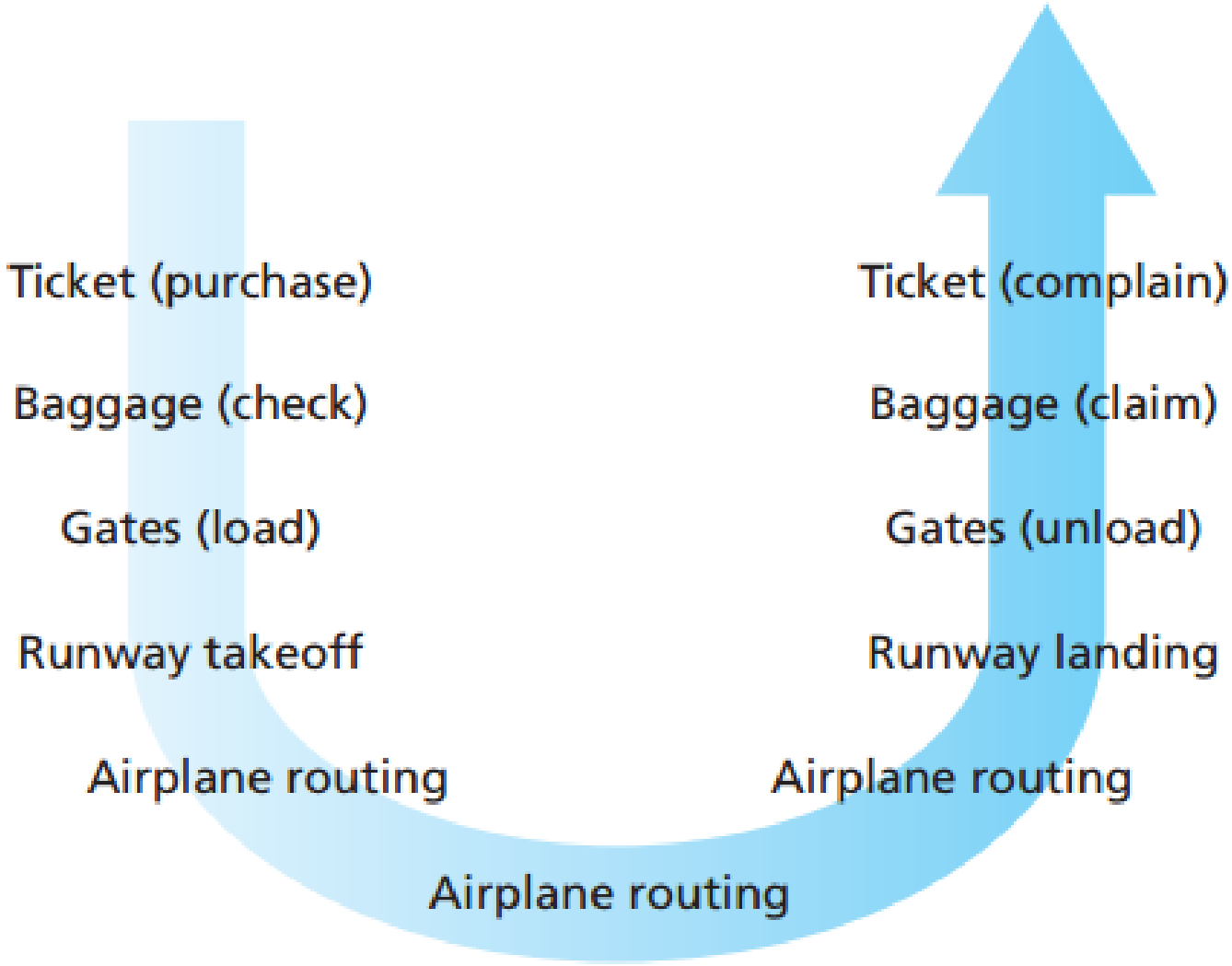
Layered Network Architecture

What is Layering?

A technique to organize a network system into a succession of logically distinct entities, such that the service provided by one entity is solely based on the services provided by the previous (lower level) entity.


Ticket (purchase)
Baggage (check)
Gates (load)
Runway takeoff
Airplane routing
Airplane routing
Ticket (complain)
Baggage (claim)
Gates (unload)
Runway landing
Airplane routing

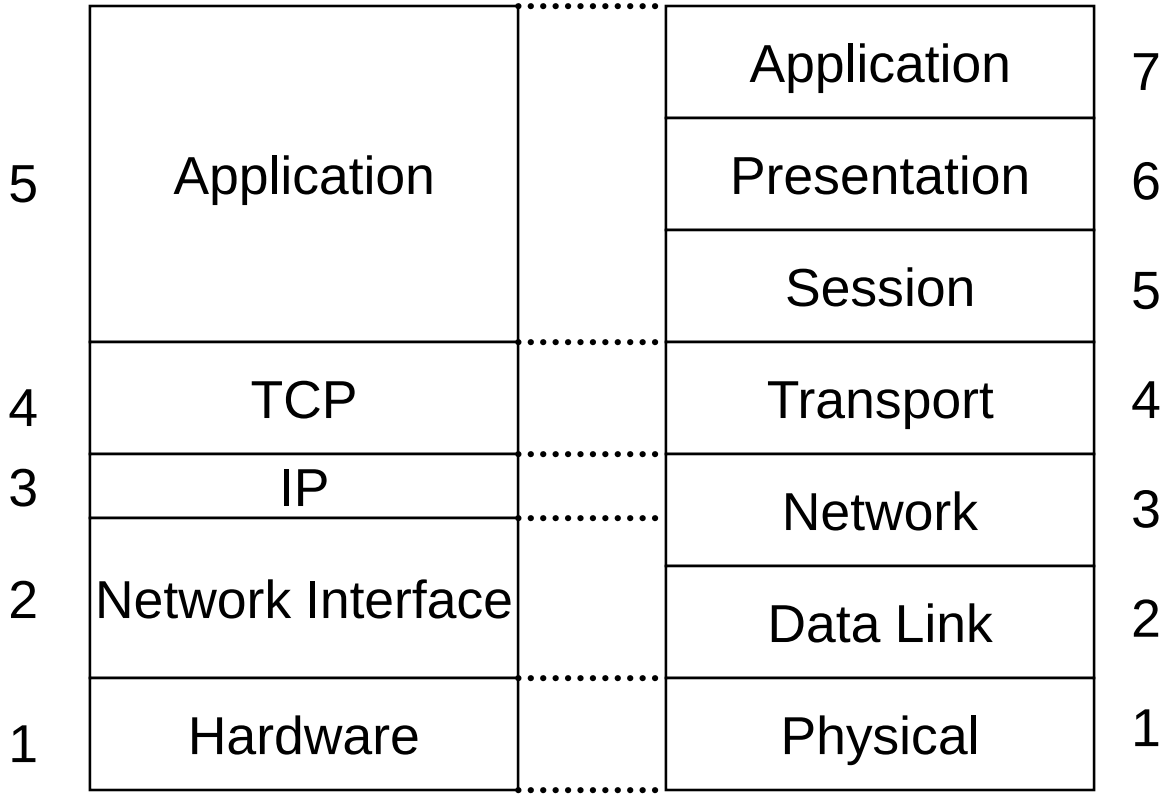
Why Layering Approach

- Solving all the problems at once is difficult.
  It's a good idea to divide problems or functions into several sets in
  such a way that:
  • problems or functions in a same set are tightly coupled
  • the inter-dependence between problems or functions in different
  sets is minimized
  Address the problem sets separately.

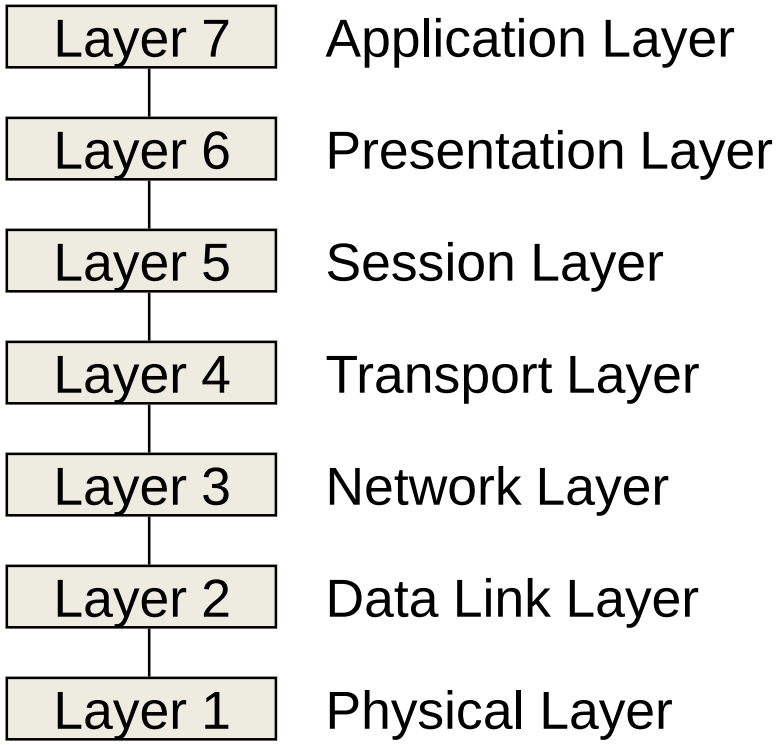
The OSI Reference Model

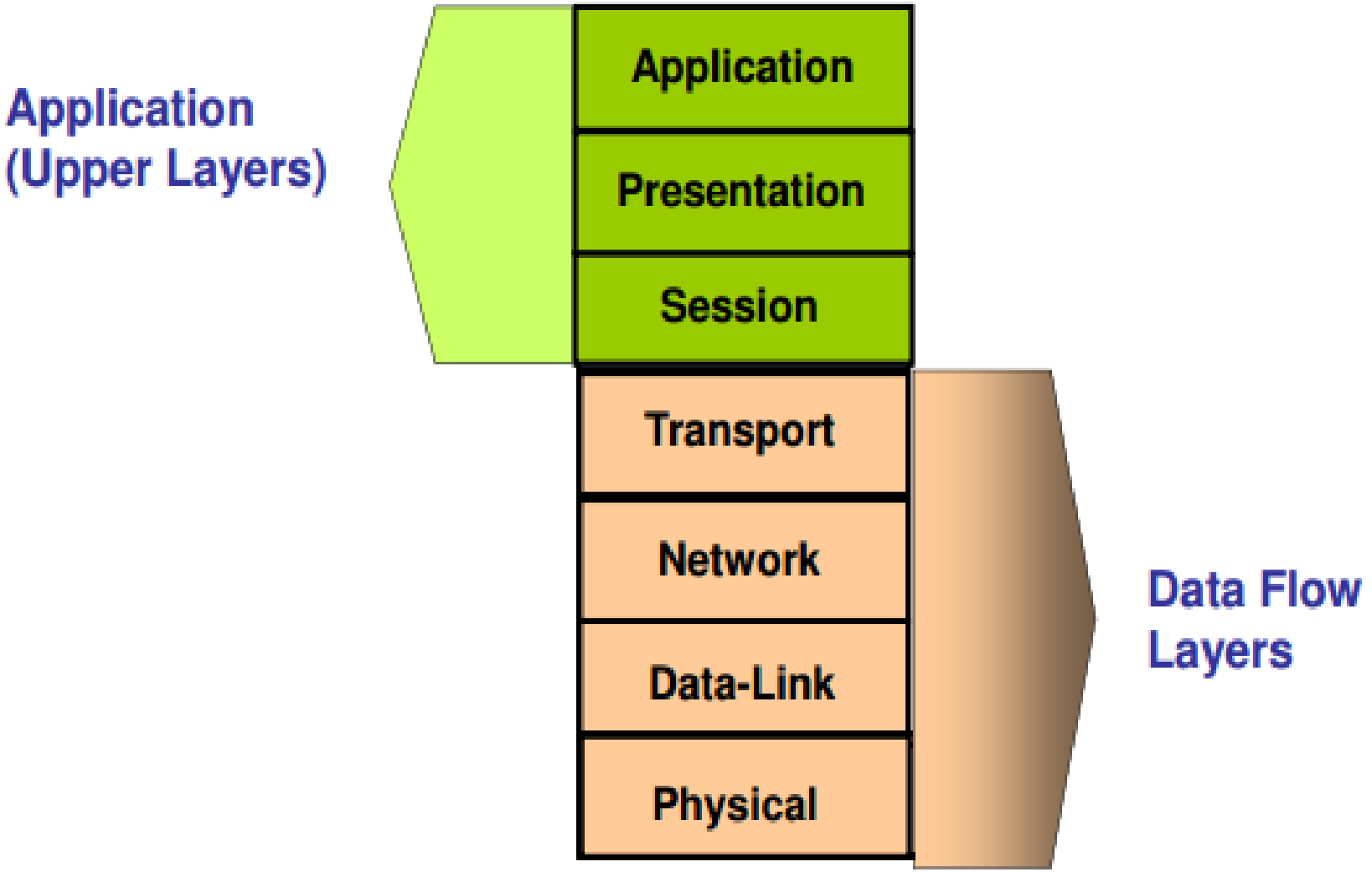
- OSI Reference Model – an internationally standardised network architecture.
- An abstract representation of an ideal network protocol stack; not used in real networks.
- OSI = Open Systems Interconnection.
- Specified in ISO 7498-1.
- Model has 7 layers.

Internet Protocols vs OSI



The OSI Model




Application
(Upper Layers)
Application
Presentation
Session
Transport
Network
Data-Link
Physical
Data Flow
Layers

Lower/Upper Layers

- Layers 1-4 often referred to as *lower layers*.
- Layers 5-7 are the *upper layers*.
- Lower layers relate more closely to the communications technology.
- Layers 1 – 3 manage the communications subnet.
  - the entire set of communications nodes required to manage massages between a pair of machines.
- Layers 4 – 7 are true ‘end-to-end’ protocols.
- Upper layers relate to application.

Layer 7: Application Layer

- Home to wide variety of protocols for specific user needs,
  e.g.:
  virtual terminal service, file transfer, electronic mail, directory services.
- Provides Applications with access to network services.

Layer 6: Presentation Layer

- Concerned with representation of transmitted data.
- Deals with different data representations.
  - ASCII or EBCDIC,
- Also deals with data compression.
- Determines the format used to exchange data among networked computers.

Layer 5: Session Layer

- Allows establishment of sessions between machines, e.g. to
  - allow remote logins
  - provide file transfer service.
- Responsible for:
  - dialogue control
    - which entity sends when with half-duplex communications.
  - token management
    - E.g. control which entity can perform an operation on shared data.
  - synchronisation
    - E.g. insertion of checkpoints in large data transfers.

- Allows two applications to establish, use and disconnect a connection between them called a session. Provides for name recognition and additional functions like security, which are needed to allow applications to communicate over the network.

Layer 4: Transport Layer

- Basic function is to take data from Session Layer, split it up into smaller units, and ensure that the units arrive correctly.
- Concerned with efficient provision of service.
- The Transport Layer also determines the ‘type of service’ to provide to the Session Layer.

- Ensures that data is delivered error free, in sequence and with no loss, duplications or corruption.
  This layer also repackages data by assembling long messages into lots of smaller messages for sending, and repackaging the smaller messages into the original larger message at the receiving end.

Layer 3: Network Layer

- Key responsibility is control of routing in the subnet.
- Routing can be based on:
  - static tables,
  - determined at start of session,
  - highly dynamic (varying for each packet depending on network load).
- Also responsible for congestion control and usage monitoring.

Network Layer

- This is responsible for addressing messages and data so they are sent to the correct destination, and for translating logical addresses and names (like a machine name FLAME) into physical addresses. This layer is also responsible for finding a path through the network to the destination computer.

Layer 2: Data Link Layer

- Provides reliable, error-free service on top of raw Layer 1 service.
- Breaks data into frames. Requires creation of frame boundaries.
- Frames used to manage errors via acknowledgements and selective frame retransmission.

- This layer takes the data frames or messages from the Network Layer and provides for their actual transmission. At the receiving computer, this layer
- receives the incoming data and sends it to the network layer for handling.
- The Data-Link Layer also provides error-free delivery of data between the two computers by using the physical layer.
- It does this by packaging the data from the Network Layer into a frame, which includes error detection information.

- At the receiving computer, the
- Data-Link Layer reads the incoming frame, and generates its own error detection
- information based on the received frames data. After receiving the entire frame, it then compares its error detection value with that of the incoming frames, and if they match,

- the frame has been received correctly.

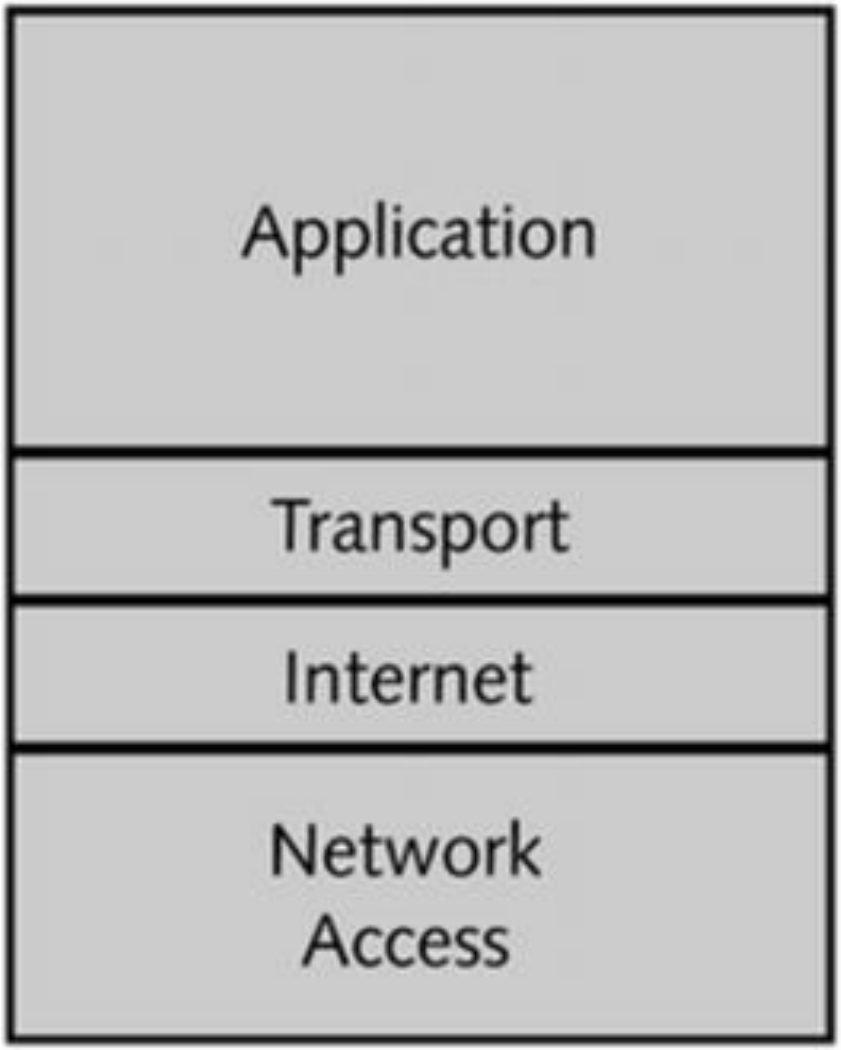
Layer 1: Physical Layer

- Concerned with bit transmission over physical channel.
- Issues include:
  - definition of 0/1,
  - whether channel simplex/duplex,
  - connector design.
- Mechanical, electrical, procedural matters.

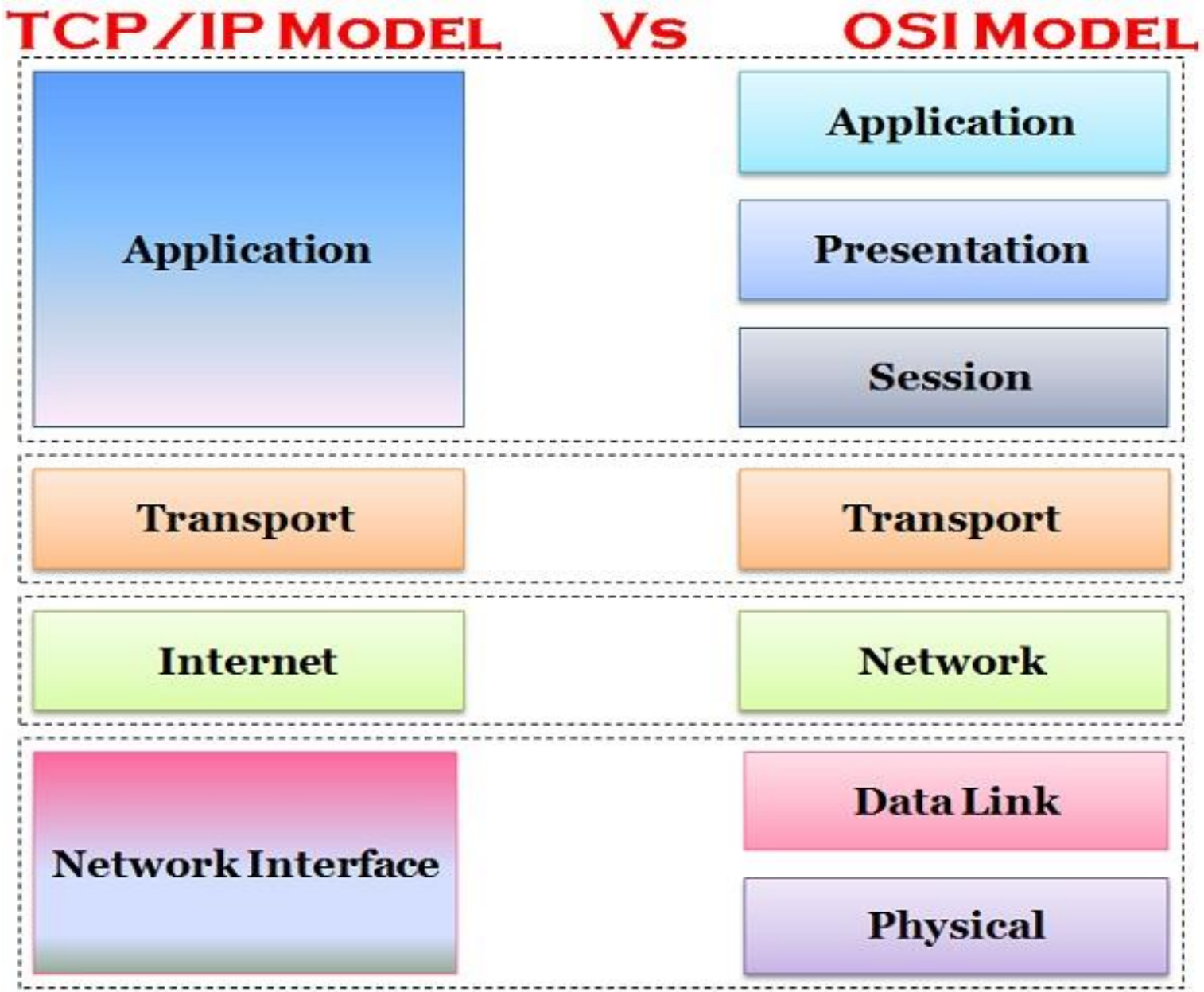
- Controls the transmission of the actual data onto the network cable. It defines the electrical signals, line states and encoding of the data and the connector types used.
  An example is 10BaseT.

TCP / IP Model

- Transmission Control Protocol/Internet Protocol, is a suite of communication protocols used to interconnect network devices on the internet.



TCP/IP model


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

TCP/IP	OSI
It has 4 layers.	It has 7 layers.
TCP/IP Protocols are considered to be standards around which the internet has developed.	OSI Model however is a "generic, protocol-independent standard."
Follows Vertical Approach	Follows Horizontal Approach
In TCP/IP Model, Transport Layer does not Guarantees delivery of packets.	In OSI Model, Transport Layer Guarantees delivery of packets.
Network Layer in TCP/IP Model provides only Connectionless service.	Network Layer in OSI Model provides both Connection-Oriented & Connection less service.
Replacing Protocol is not easy.	Protocols are hidden in OSI model & are easily replaced as the technology changes.
TCP/IP protocols are the standards around which the internet was developed therefore it mainly gains creditability due to this reason.	Where as in contrast networks are not usually built around the OSI model as it is merely used as a guidance tool.
Not found in TCP/IP model. In TCP/IP, its characteristics are provided by the TCP protocol.	The Session layer permits two parties to hold ongoing communications called a session across a network.
The TCP/IP network model represents reality in the world.	Whereas the OSI mode represents an ideal.
Combines the session and presentation layer in the application layer.	Has separate session and presentation layer.
Protocols were developed first and then the model was developed.	Model was developed before the development of protocols.
Protocol dependent standard.	Protocol independent standard.