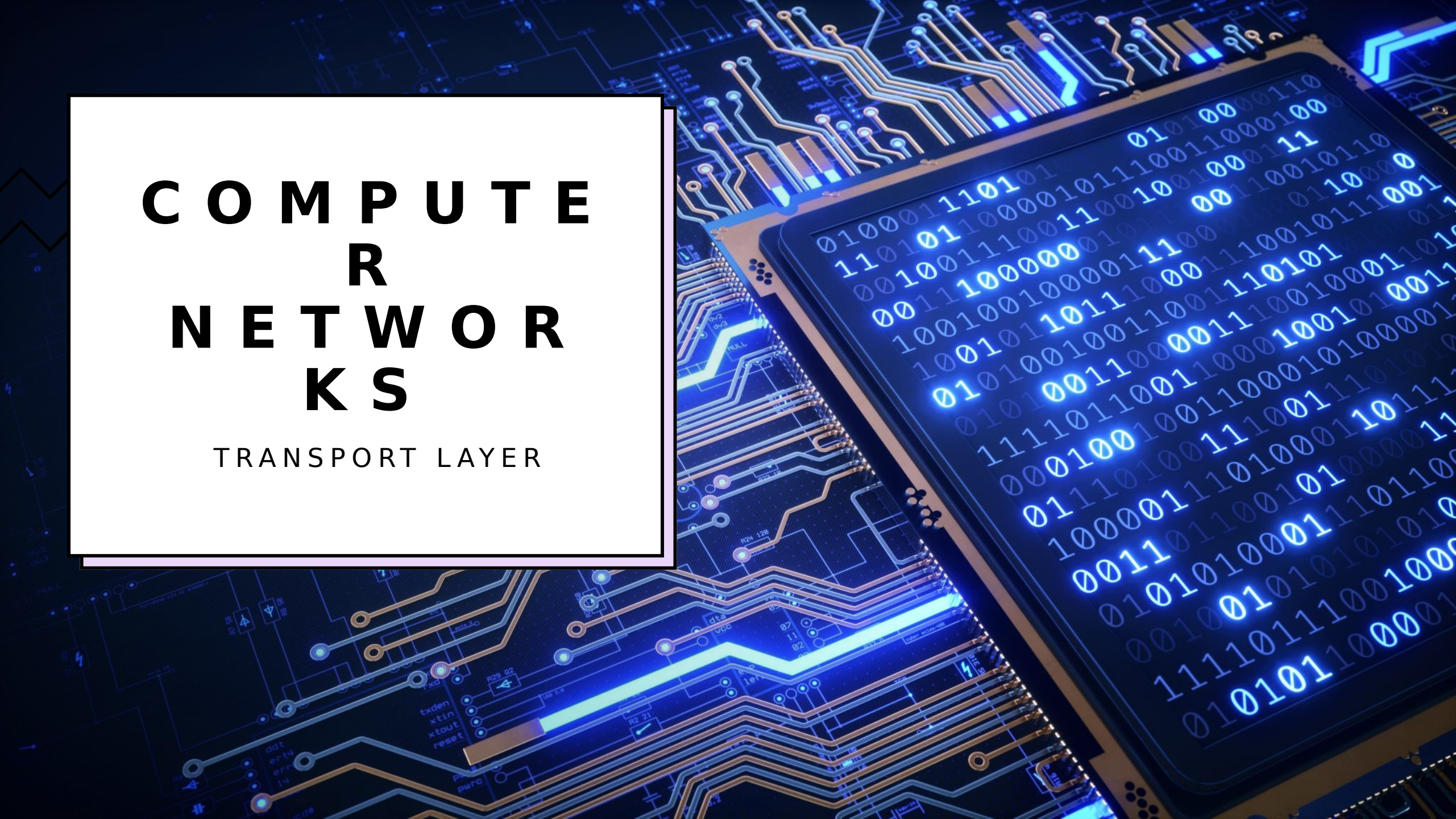


COMPUTER NETWORKS

TRANSPORT LAYER

Topics of the day

- Transport Layer
- Services
  - Process-to-Process Communication
  - Addressing: Port Numbers
  - Multiplexing and Demultiplexing
  - Flow Control
  - Error Control
  - Congestion Control
- Connectionless & Connection-Oriented Protocols

Transport Layer

- Between Application and Network Layer
- Provides services to the application layer
- Ensures Process-to-process delivery
- Also called Heart of TCP/IP protocol suite
- End-to-End Logical vehicle

- IP Telephony
- Streaming Video

- SMTP/POP (Email)
- HTTP

TCP/IP Model

OSI Model

Application
Presentation
Session
Transport
Network
Data Link
Physical

Application
Transport
Internet
Network Access

Required Protocol Properties
- Fast
- Low overhead
- Does not require acknowledgements
- Does not resend lost data
- Delivers data as it arrives

Required Protocol Properties
- Reliable
- Acknowledge data
- Resend lost data
- Delivers data in order sent

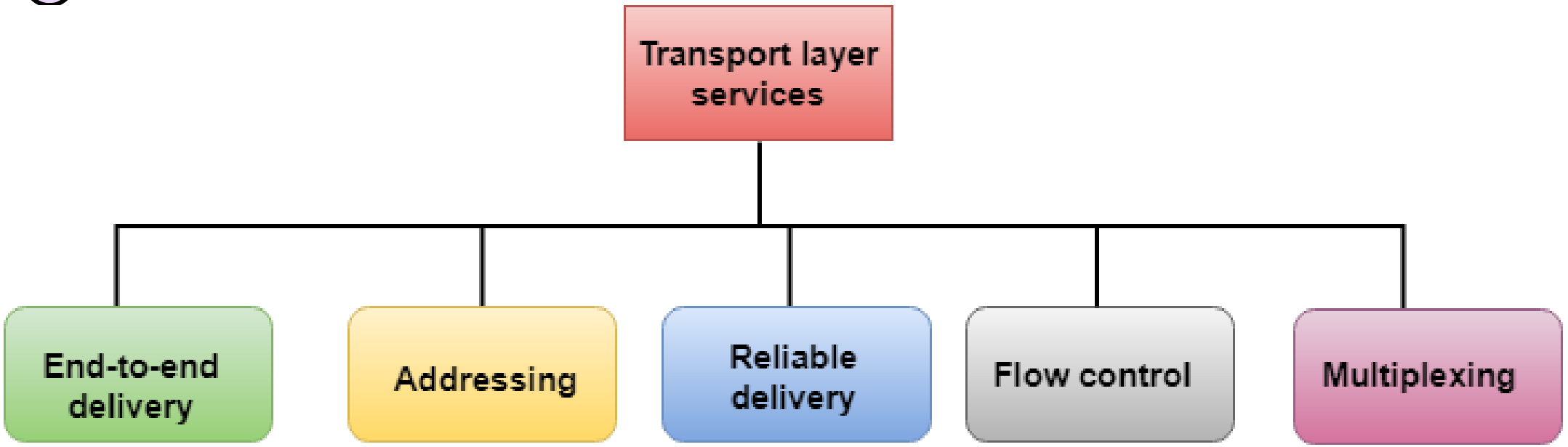
Application developers choose the appropriate Transport Layer protocol based on the nature of

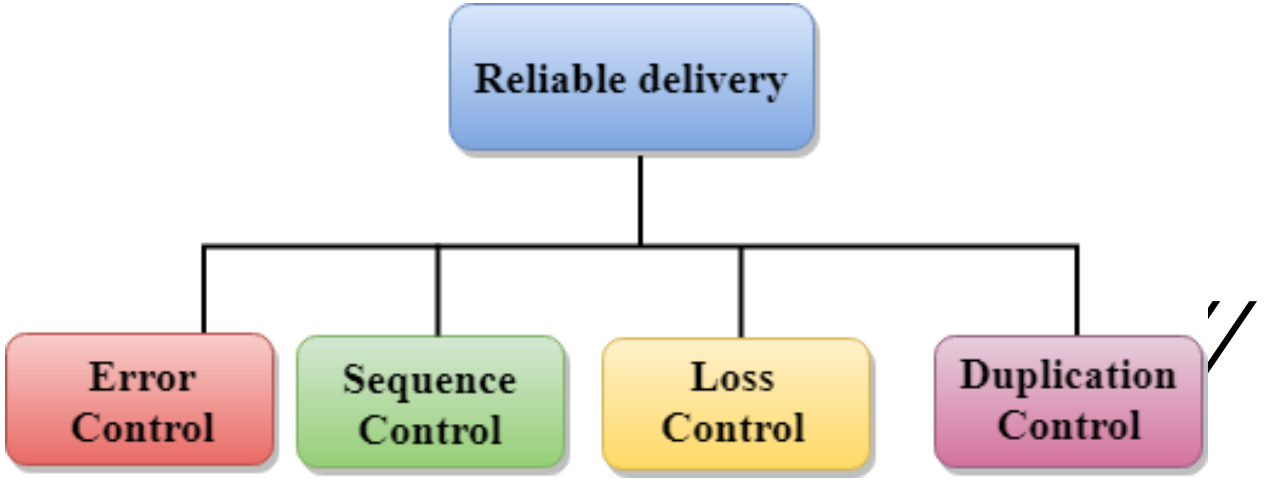
Services

Services provided by transport layer to the application layer are:

- Process-to-Process Communication
- Addressing: Port Numbers
- Multiplexing and Demultiplexing
- Flow Control
- Error Control
- Congestion Control

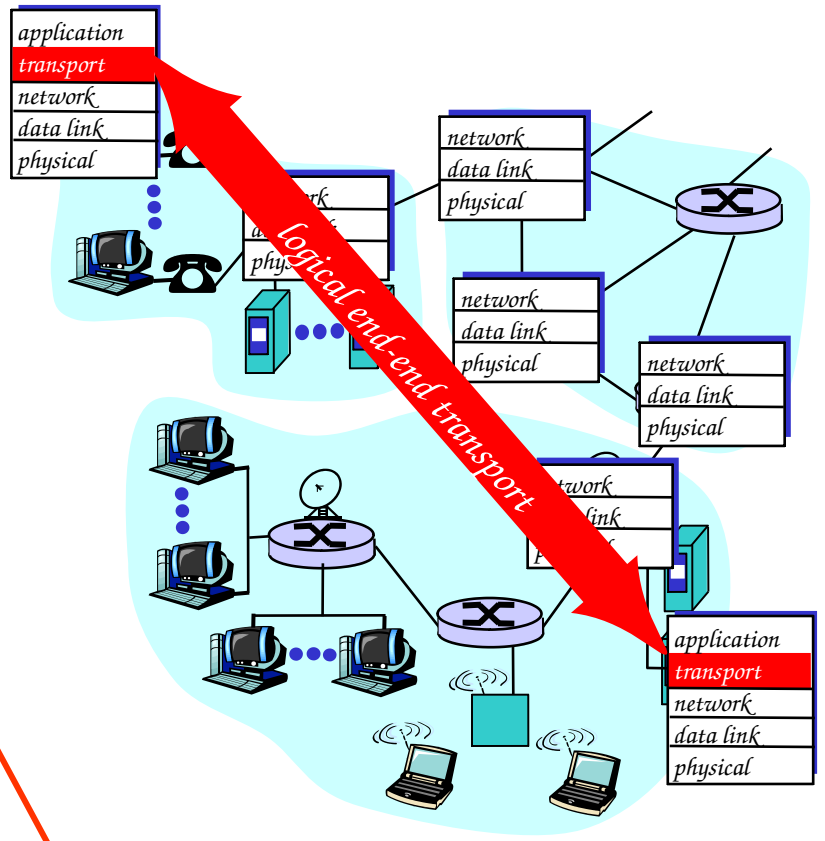
Services


Transport layer services
End-to-end delivery
Addressing
Reliable delivery
Flow control
Multiplexing


Reliable delivery
Error Control
Sequence Control
Loss Control
Duplication Control

Transport Services & Protocols

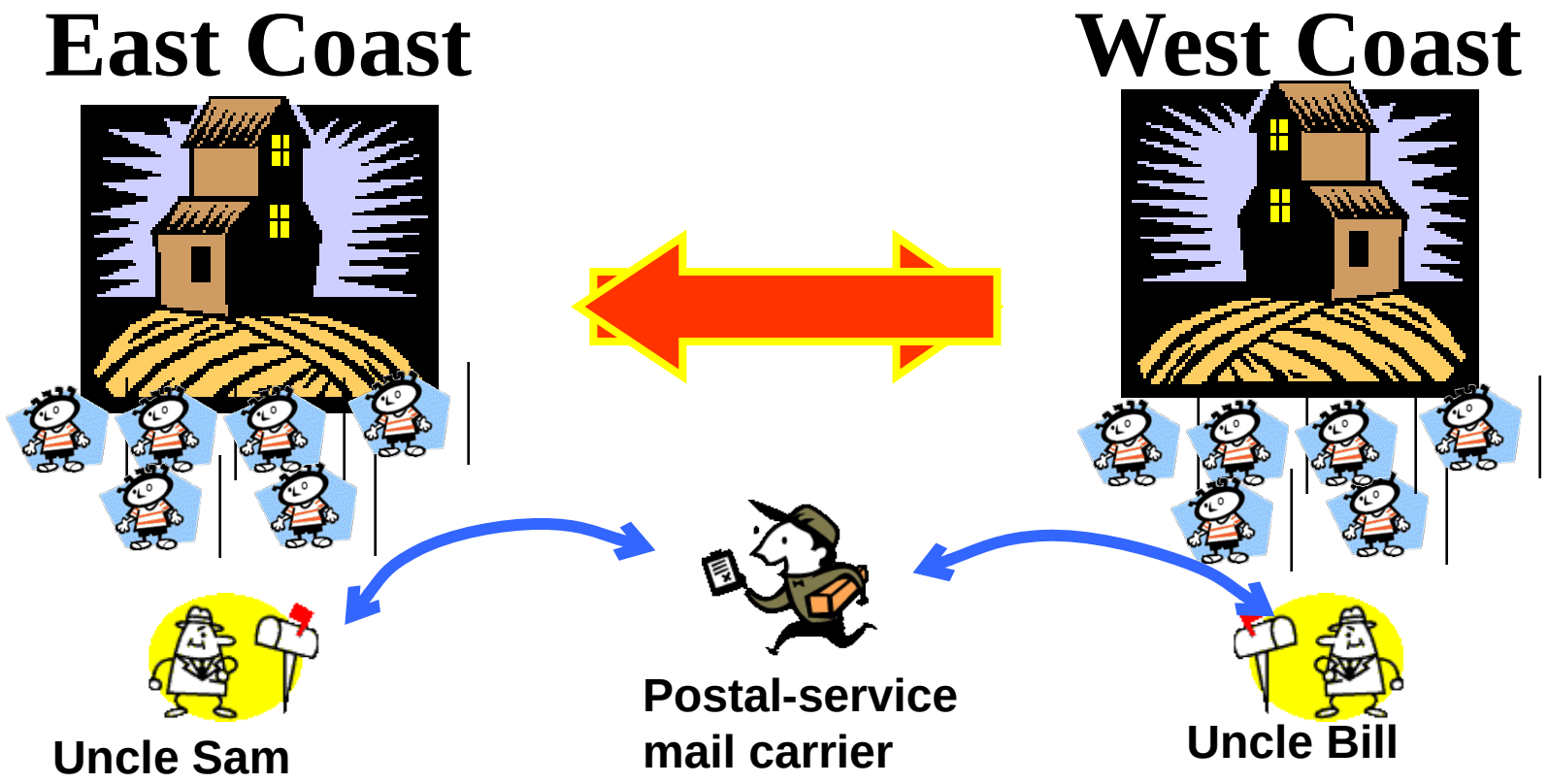
- provide ***logical communication*** between app' processes running on different hosts
- implemented in end systems, but not in network routers
- transport vs network layer services:
  - ***network layer:*** data transfer between end systems
  - ***transport layer****:* data transfer between processes
    - relies on, enhances, network layer services
    - Constrained by service model of Network-layer protocol



Let's look at a simple analogy to see their subtle differences

Transport Layer V/S Network Layer

An Analogy: Cousins sending letters



- Uncle Sam & Uncle Bill - responsible for mail collection, distribution, and communicating with postal service
- Postal service – carries the mails from house to house

Transport V/S Network Layer

hosts *(also called end systems)* = ?
processes = ?
application messages = ?
network layer protocol = ?
transport layer protocol = ?

Transport V/S Network Layer

Their services are constrained by the possible services that the postal service provides

hosts *(also called end systems)* = houses

processes = cousins

application messages = letters in envelope

transport layer protocol = Uncle Sam and Uncle Bill

network layer protocol = postal service (including mail persons)

It may so happen that their uncles could get sick, and so other people may take over – analogously, the computer network may provide multiple transport protocols

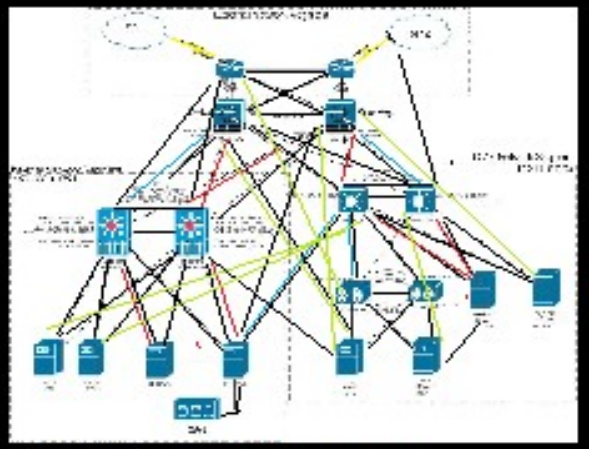
Network Engineer

What my parents think I do.

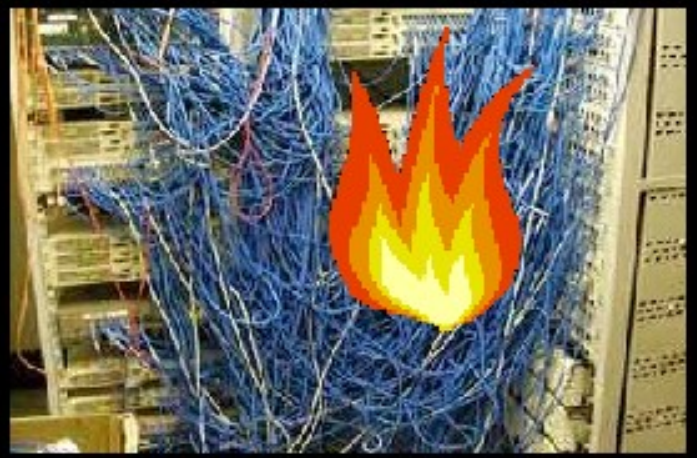
What my friends think I do.

What society thinks I do.

What my boss thinks I do.



What I think I do.



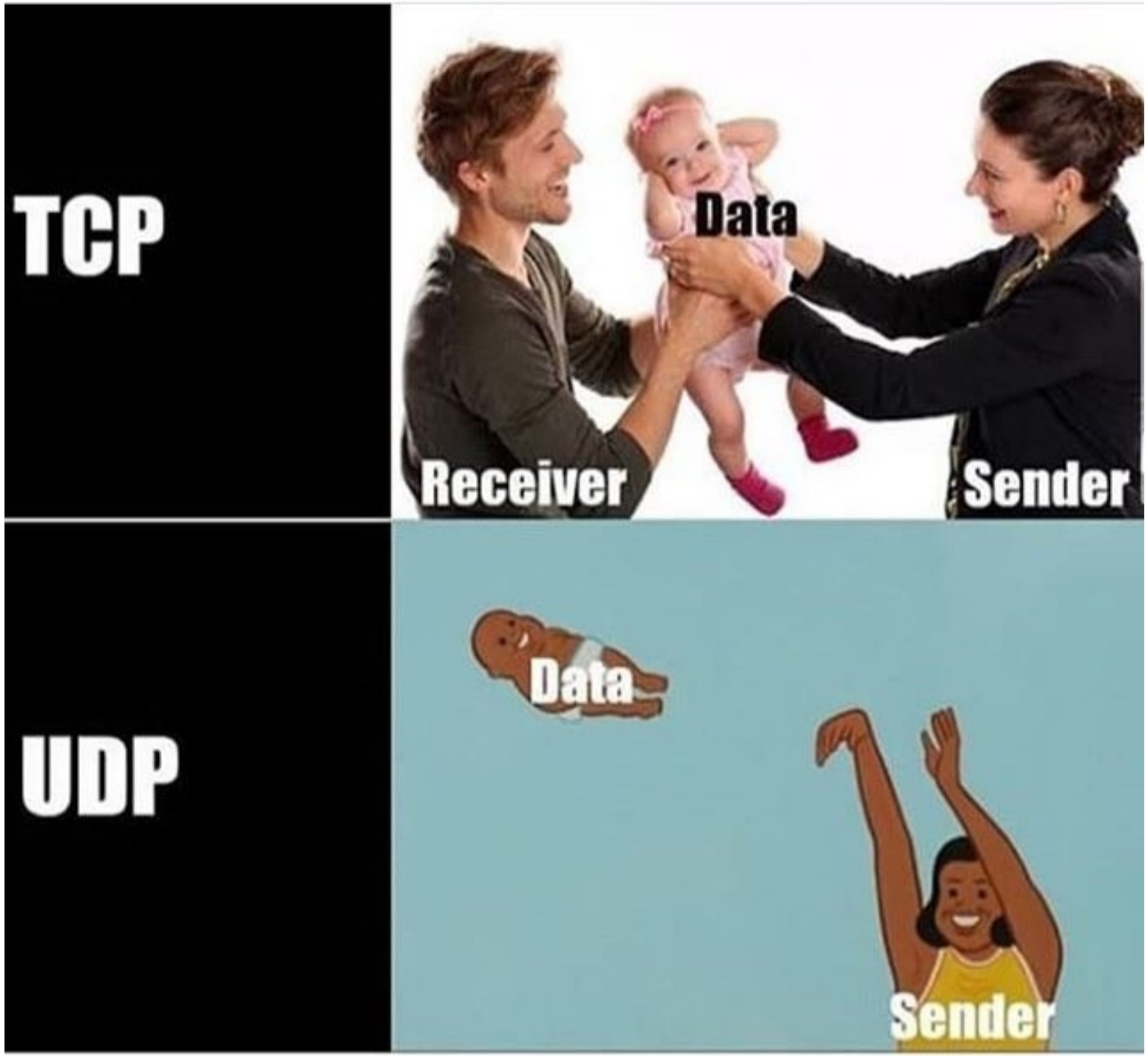
What I actually do.

Transport layer protocol

- A transport layer protocol can be either connectionless or connection-oriented.

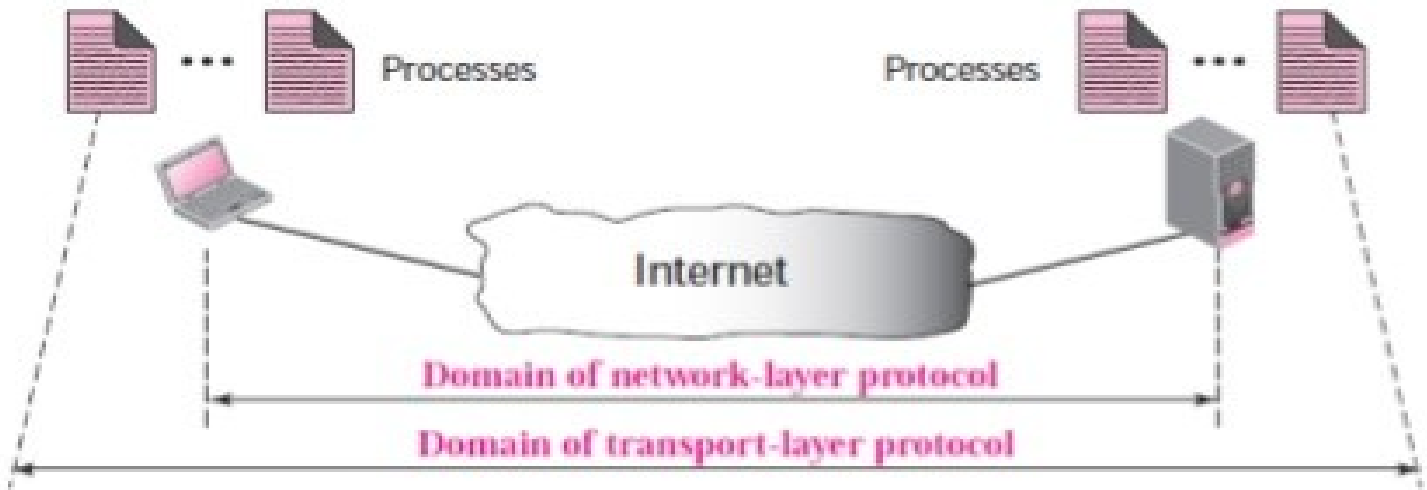
- UDP-Connectionless protocol-Simple
- TCP-Connection oriented protocol-Complex
- SCTP-Connection oriented protocol-Designed for Multimedia application

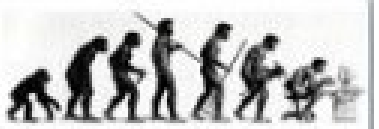
- (Stream control transport protocol)


TCP
Data
Receiver
Sender
UDP
Data
Sender

Process-to-Process Communication

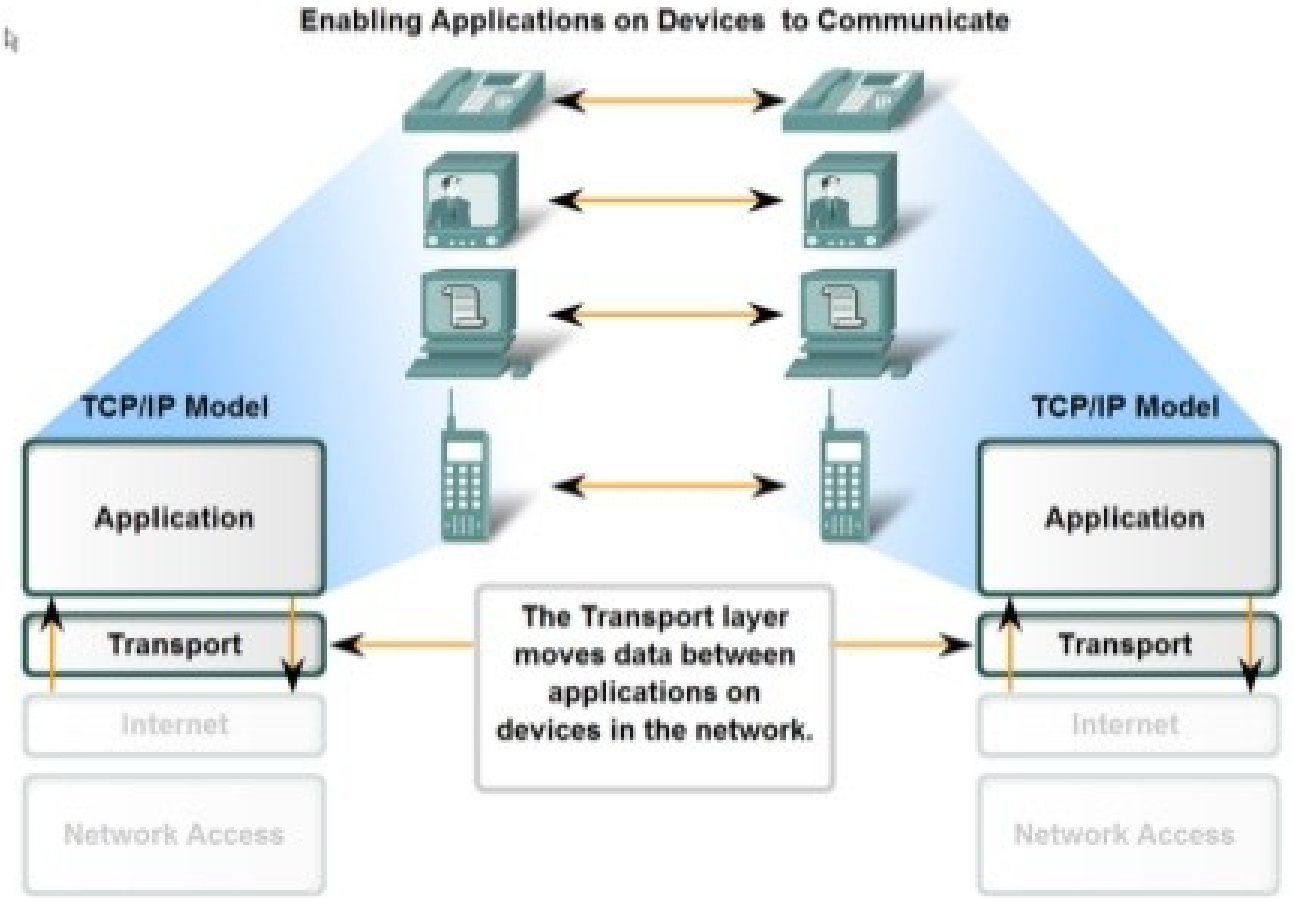
- Transport-layer protocol provides **process-to-process communication.**
- A process is an application-layer entity (**running program**) that uses the services of the transport layer.
- Host-to-host communication vs. process-to-process communication



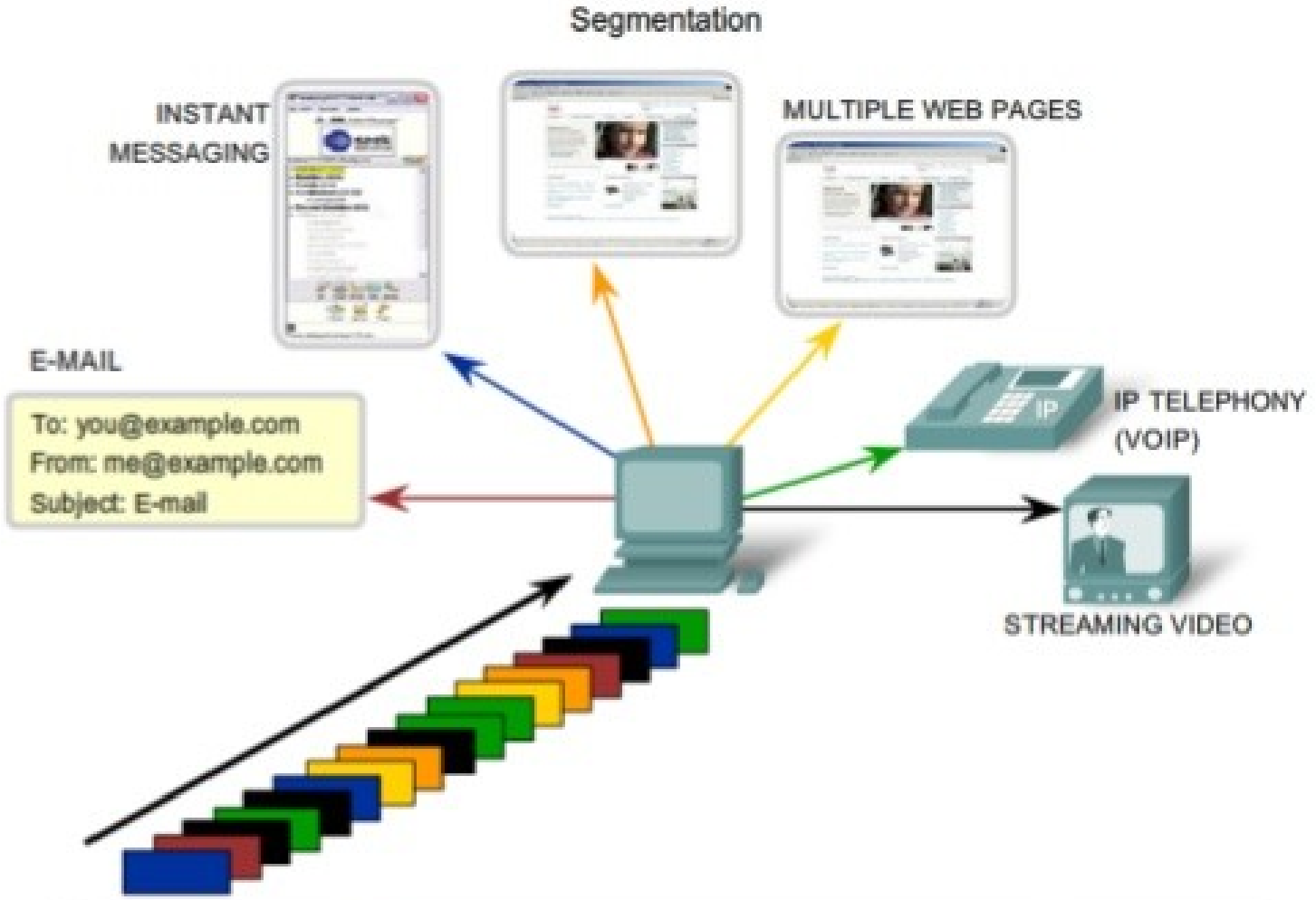


Transport Layer Role and Services

- Major functions of the transport layer and the role it plays in data networks

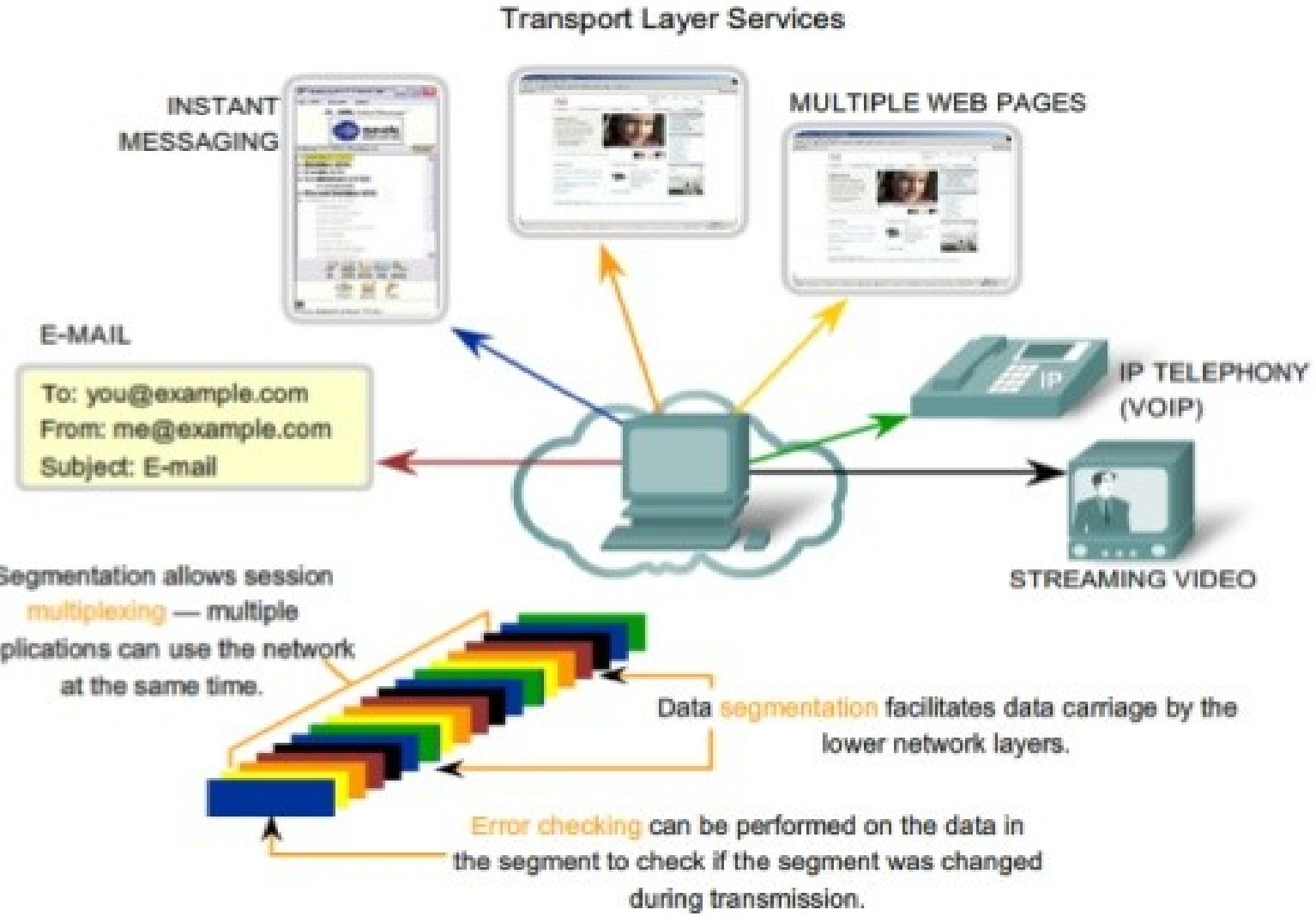


Transport Layer Role and Services

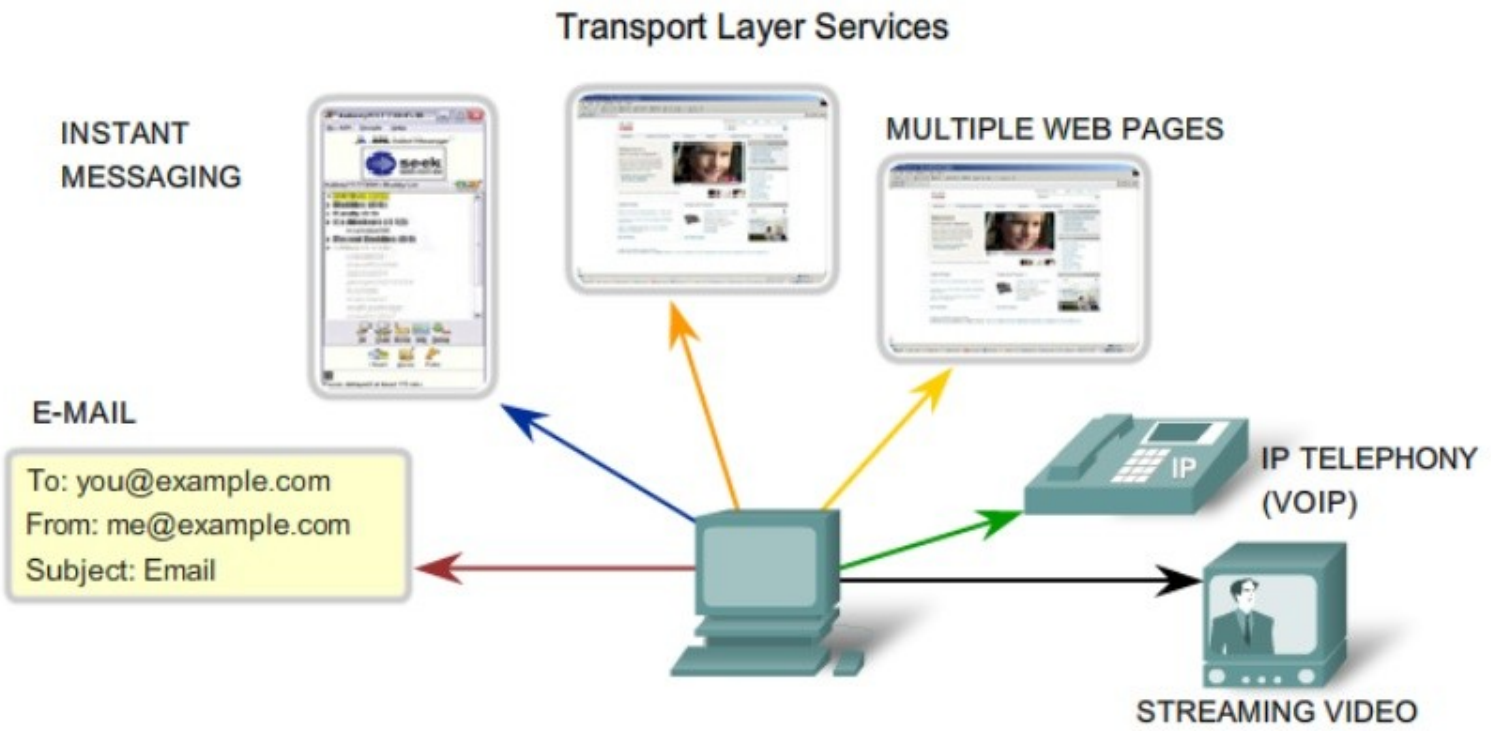


The Transport layer divides the data into segments that are easier to manage and transport.

Transport Layer Role and Services



Summary



Establishing a Session ensures the application is ready to receive the data.

Reliable delivery means lost segments are resent so the data is received complete.

Same order delivery ensures data is delivered sequentially as it was sent.

Flow Control manages data delivery if there is congestion on the host.

References

- https://www.slideshare.net/jagadish2017/transport-layer-protocol
- https://www.slideshare.net/MelvinCabatuan1/transport-layer-services