COMPUTER NETWORKS

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Unit – 5 Link Layer and LAN Roadmap

- Introduction
- Error detection, correction
- Multiple access protocols
- LANs
  - Addressing, ARP
  - Ethernet
  - Switches
- A day in the life of a web request

- Physical layer
  - Purpose, Signals to Packets
  - Analog Vs Digital Signals
  - Transmission Media
- Wireless LANs: IEEE 802.11

COMPUTER NETWORKS

Class 53 : Intro to Physical layer : Learning Objectives

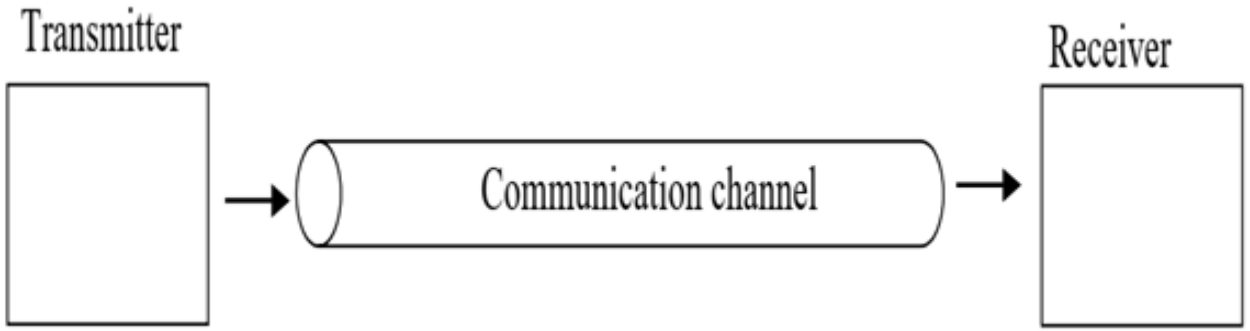
- Purpose
- Signals to Packets

Physical layer

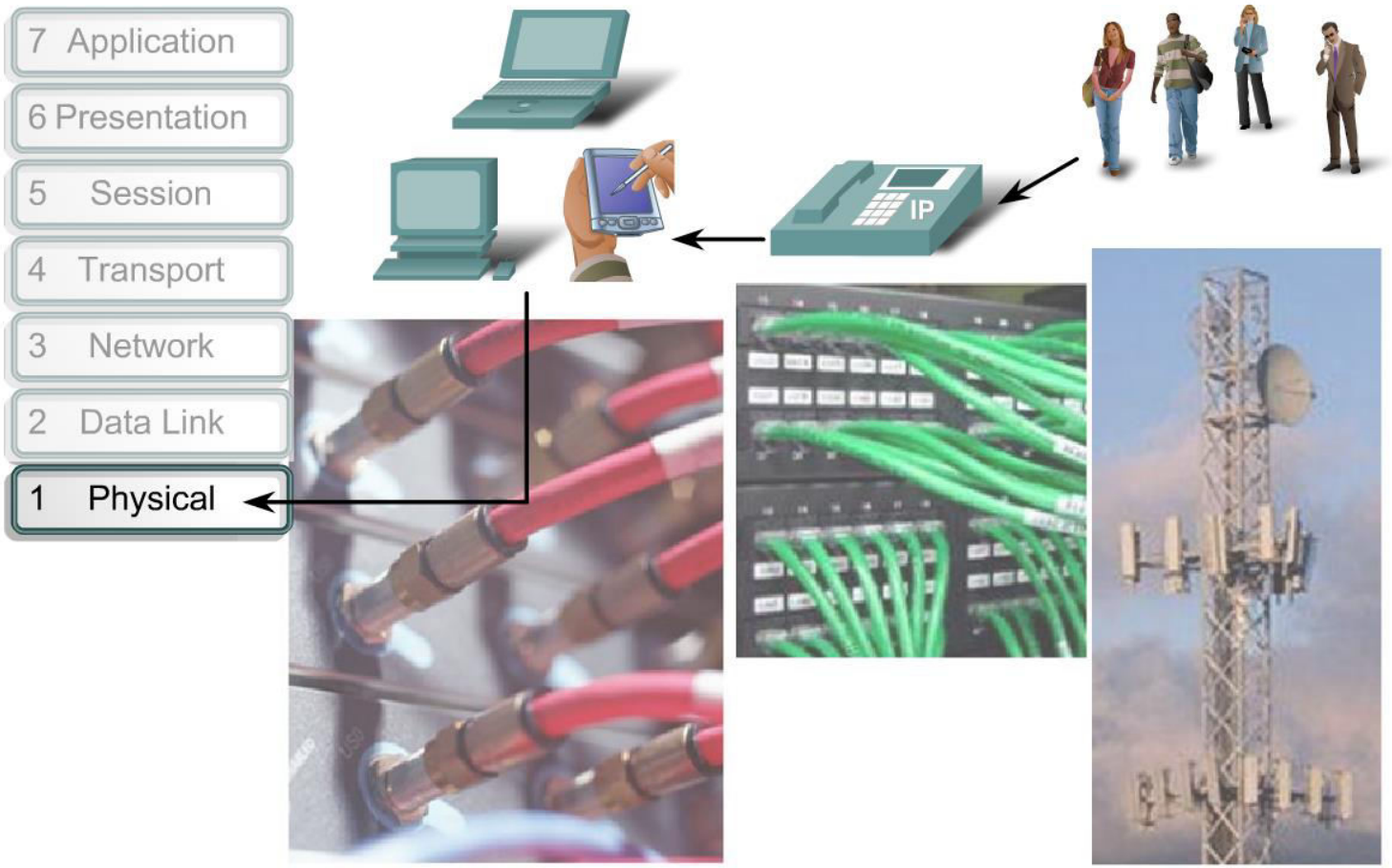
Role:

- encode the binary digits that represent data link layer frames into signals
- to transmit and receive these signals across the physical media
  - copper wires, optical fiber, and wireless that connect network devices.

Physical medium : capable of conducting a signal in the form of voltage, light, or radio waves from one device to another.



Physical layer

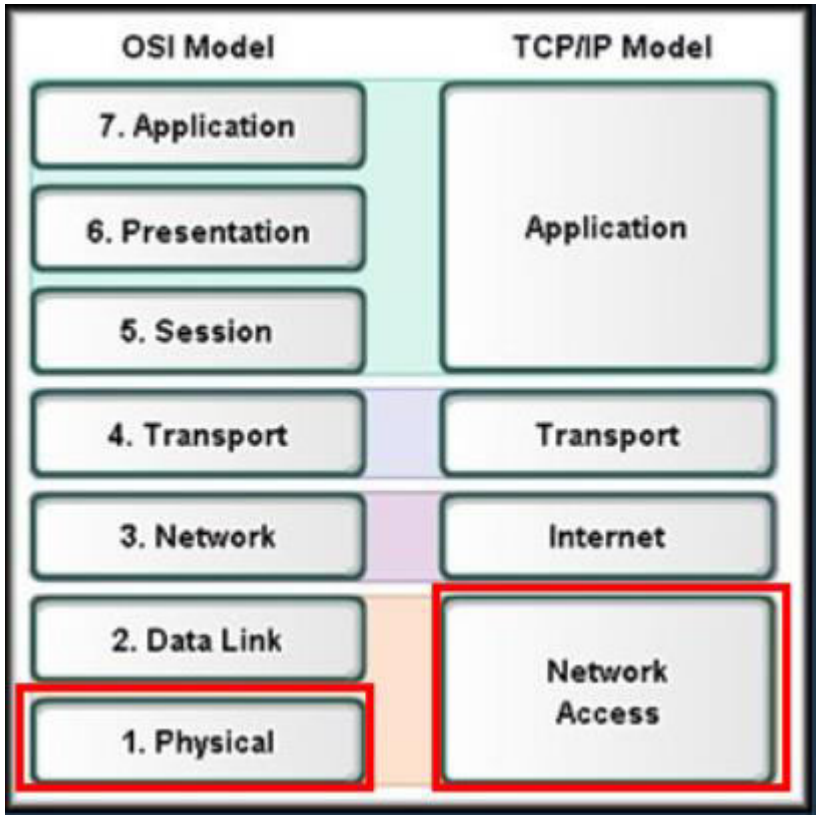


The Physical layer interconnects our data networks.

The Physical layer consists of hardware, in the form of

- electronic circuitry,
- media, and
- connectors.

Physical Layer

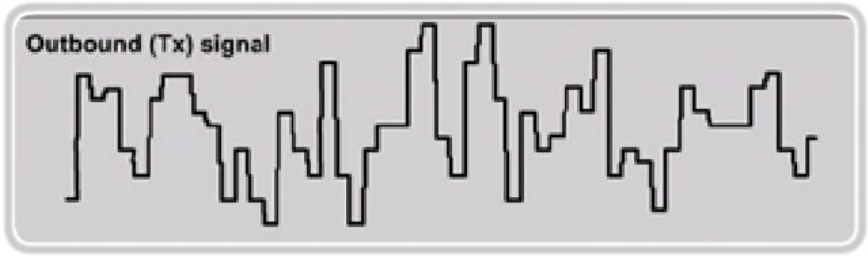


Purpose:

- *Primary Purpose:*
  - *Representation of the bits of a frame on the media in the form of signals*
- The physical media and associated connectors
- Encoding of data and control information
- Transmitter and receiver circuitry on the network devices

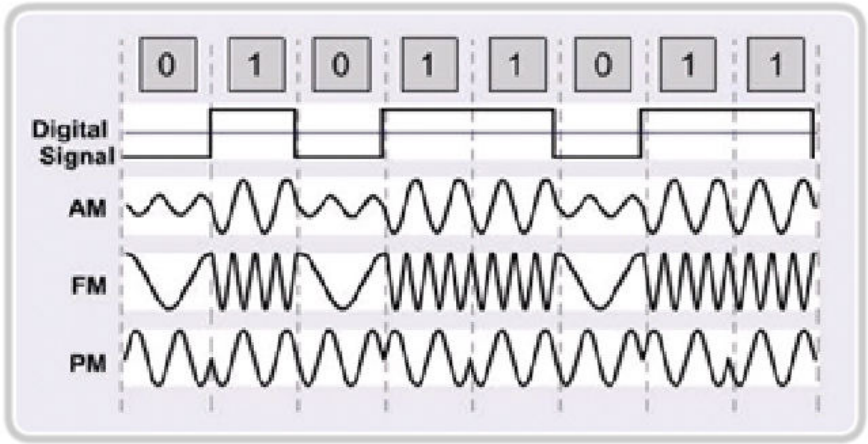
Physical Layer Operation

Representations of Signals on the Physical Media



Sample electrical signals transmitted on copper cable

Representative light pulse fiber signals



Microwave (wireless) signals

Each medium has a unique method of representing bits (signaling)

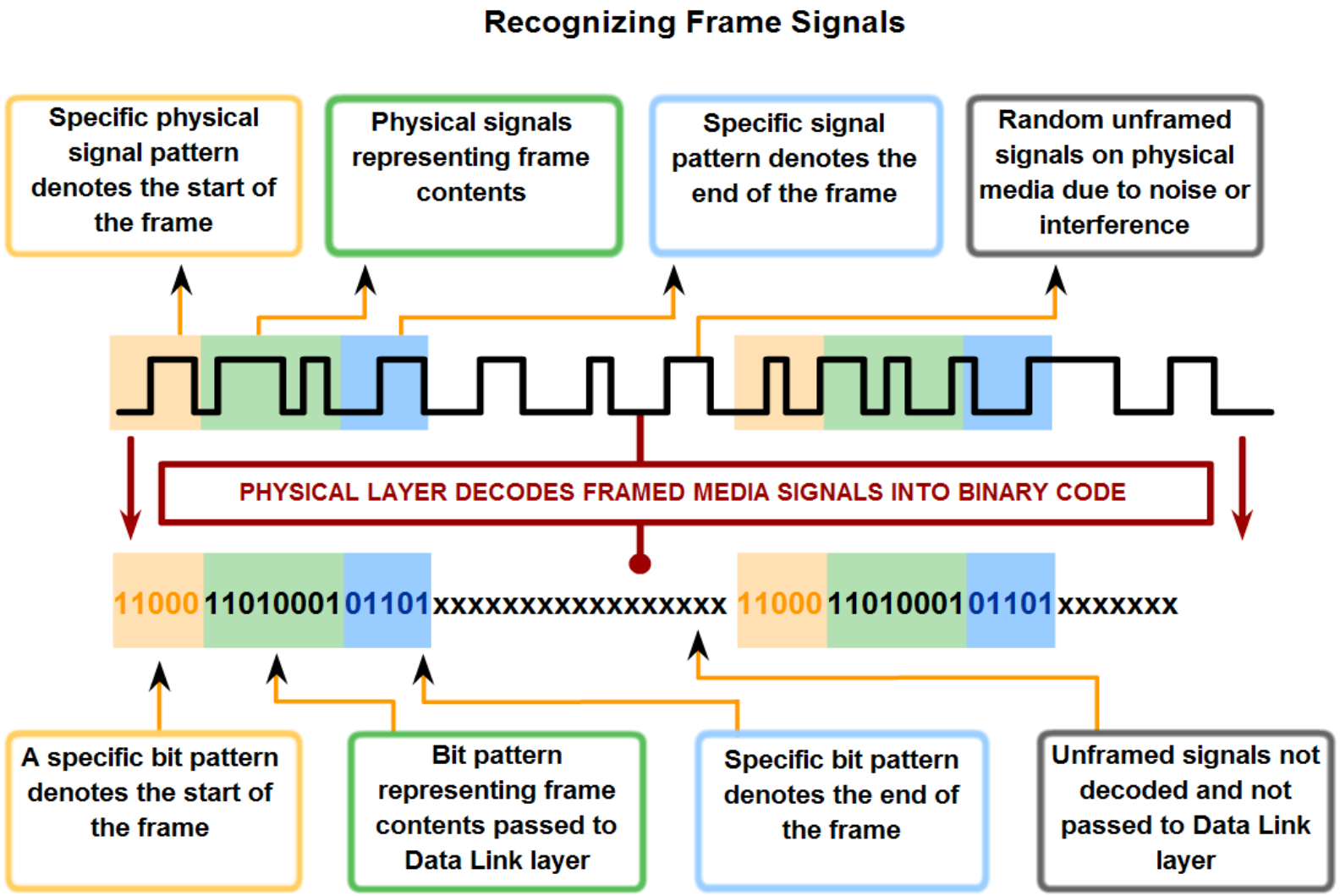
Table 8-1 Signal Types for Each of the Media at the Physical Layer

Media	Signal Type
Copper cable	Patterns of electrical pulses
Fiber-optic cable	Patterns of light pulses
Wireless	Patterns of radio transmissions

Physical Layer Operation

- When the physical layer puts a frame out onto media, it generates a set patterns of bits, or signal pattern, that can be understood by the receiving device.
- Many OSI Layer 1 technologies require the adding of signals at the beginning and the end of frames.
- To mark the beginning and end of frames, the transmitting device uses a bit pattern that is unique and is only used to identify the start or end of frames.

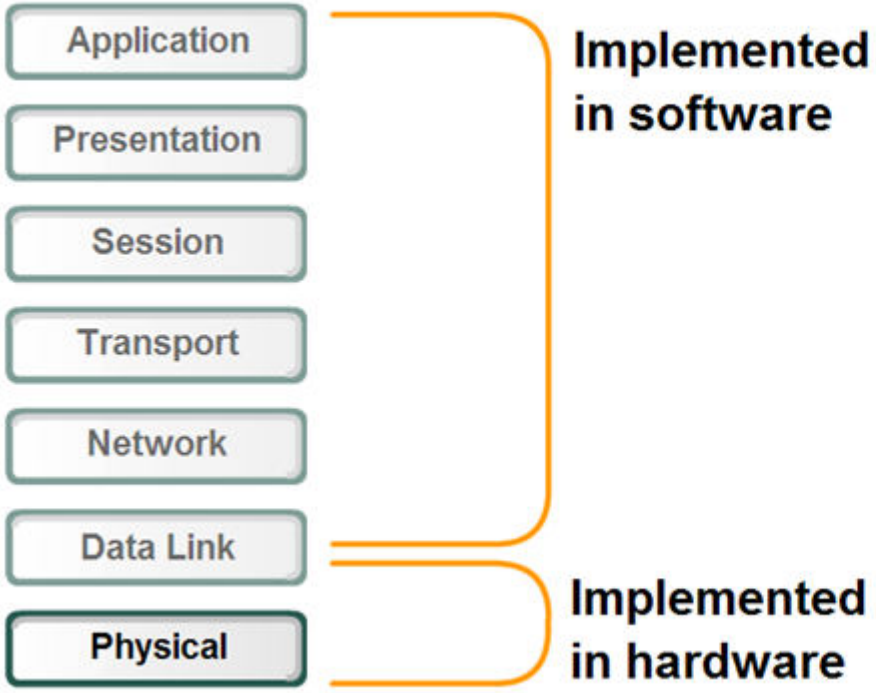
Physical Layer Operation



Key Challenge

- Digital computers
  - 0s and 1s
- Analog world
  - Amplitudes and frequencies

Physical Layer Standards



TCP/IP Standards set by:
IETF

Standards set by:
ISO IEEE
ANSI ITU
EIA/TIA FCC

Physical Layer

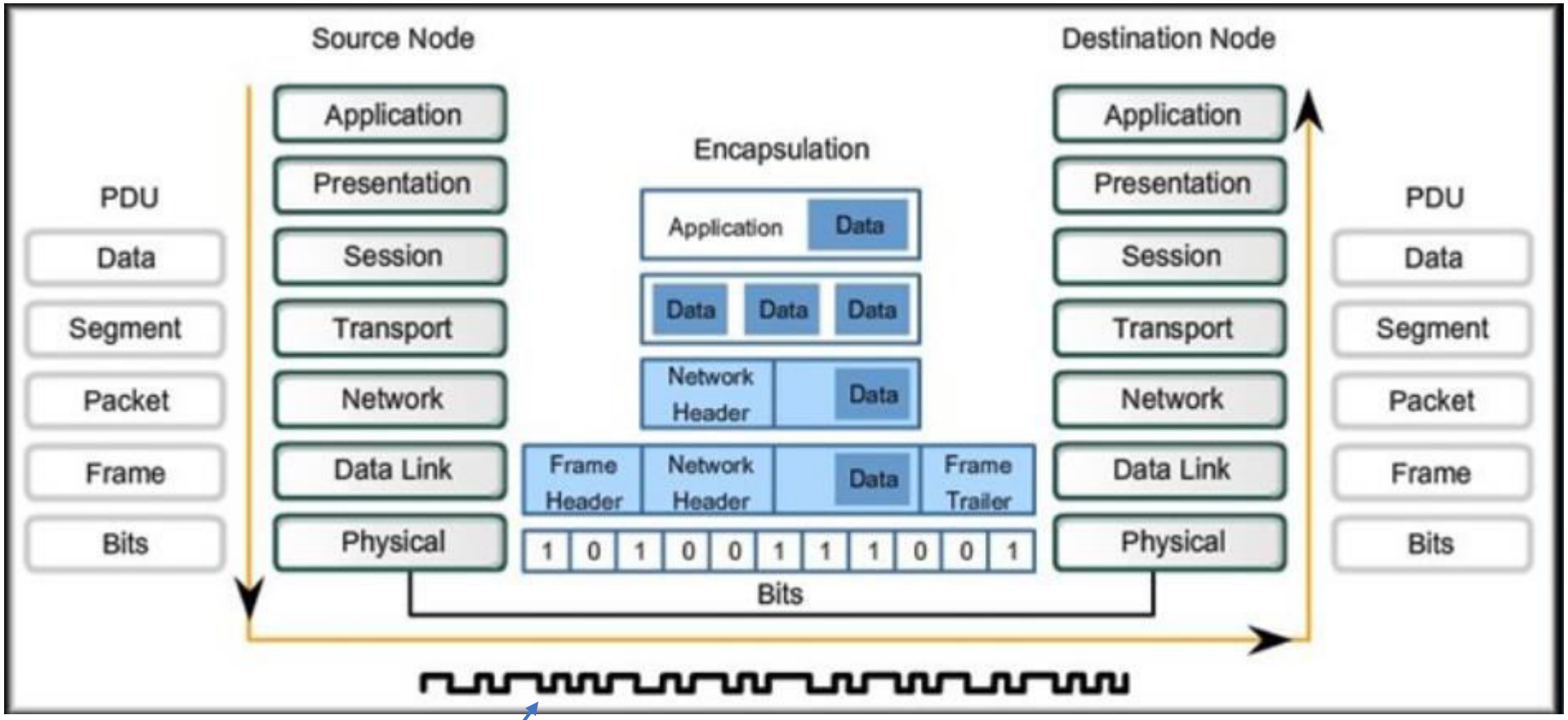
Hardware components such as

- network adapters (NICs),
- interfaces and connectors,
- cable materials
- cable designs

Determine

- Physical and electrical properties of the media
- Mechanical properties (materials, dimensions, pinouts) of the connectors
- Bit representation by the signals (encoding)
- Definition of control information signals

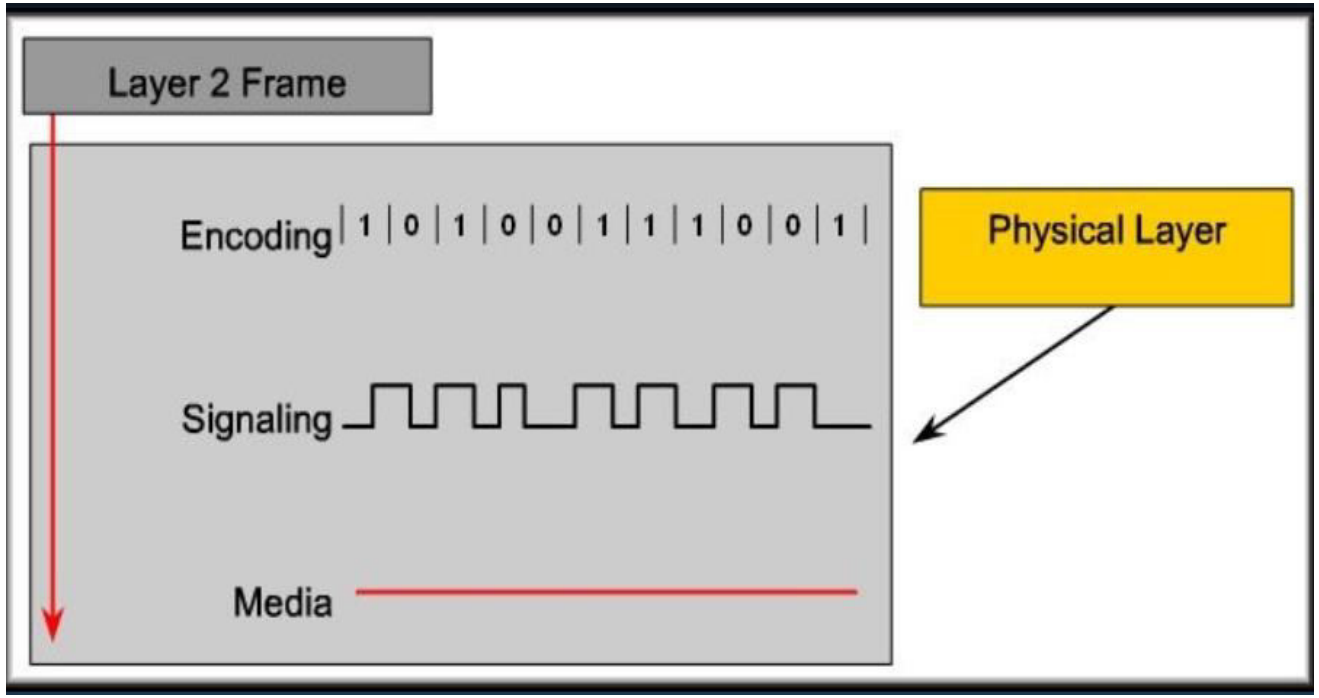
Physical Layer



Encoded signal

Physical layer Fundamental Principles

- The physical components
- Data encoding-Computing the stream of data bits from higher layers into a predefined code
- Signaling –Generation of the electrical/optical/wireless signals that represent the data bits

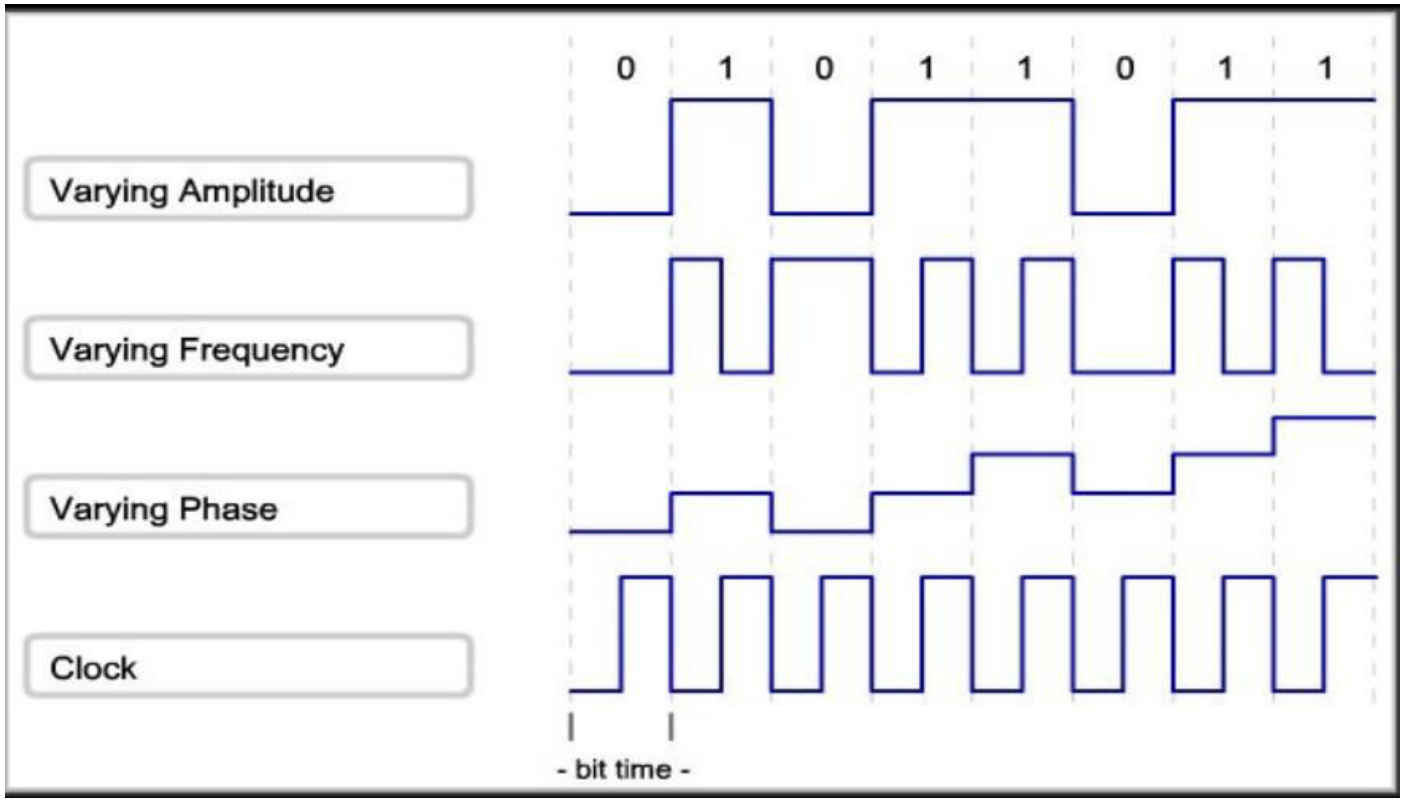


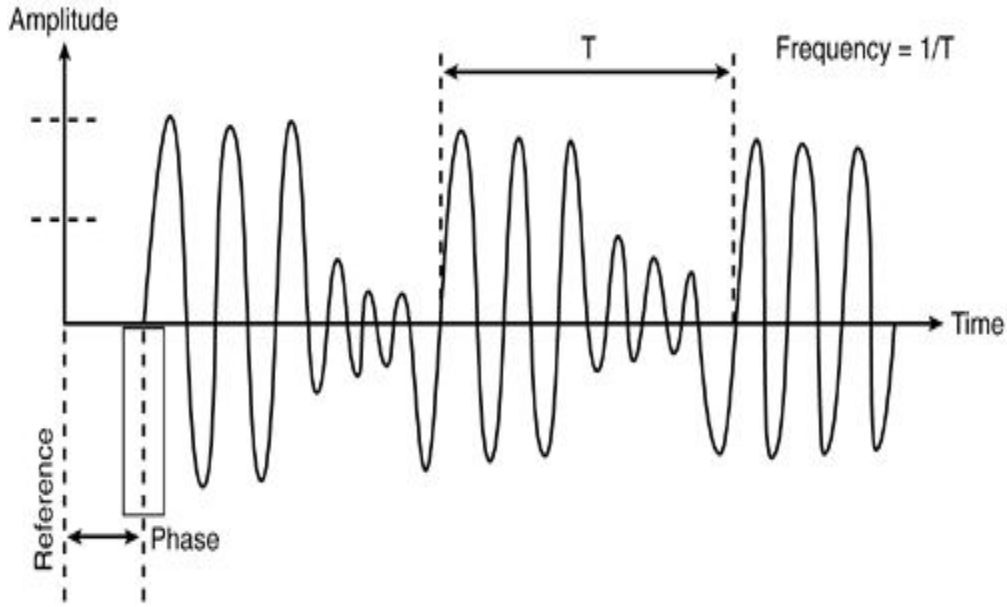
Physical Signaling and Encoding : Representing Bits

Signaling Bits for the Media

- *All communication from the human network becomes binary digits, which are transported across the physical media*
  - Transmission occurs as a stream of bits sent one at a time
  - Each of the bits in the frame represented as a signal
  - Bit time
    - Each signal has a specific amount of time to occupy the media
    - Each method finds a way to convert a pulse of energy into a defined amount of time
    - Time taken for a NIC at OSI Layer 2 to generate 1 bit of data and send it out to the media as a signal.

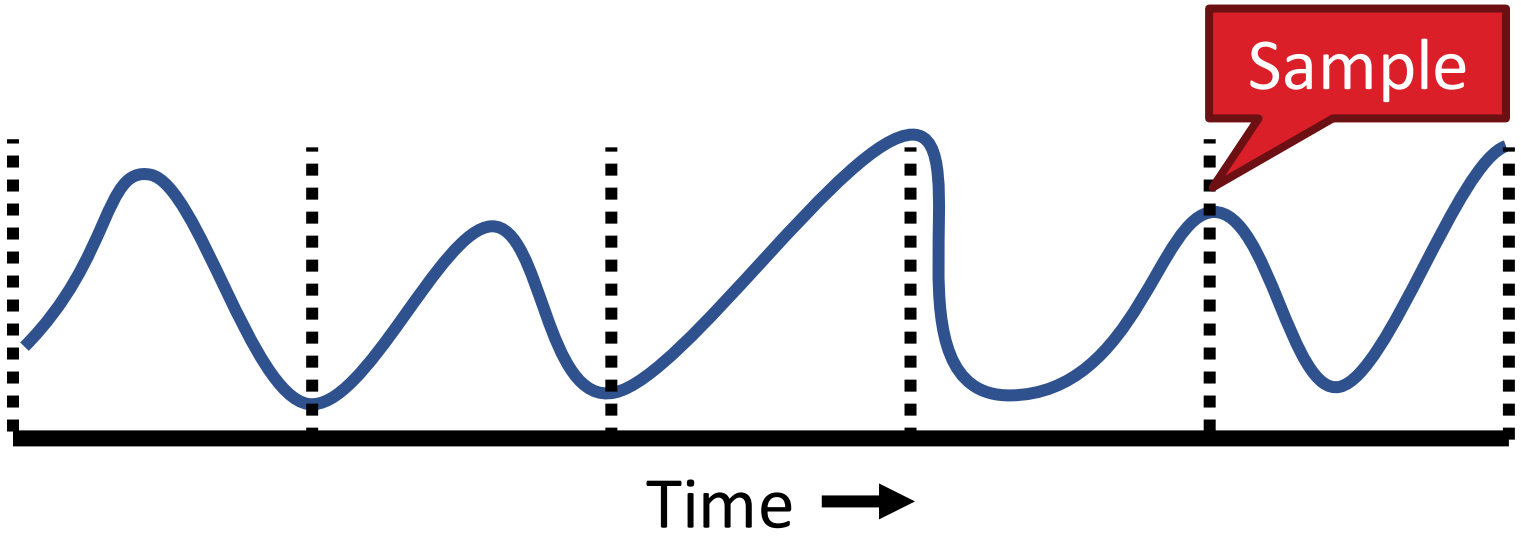
Signaling Bits for the Media





Assumptions

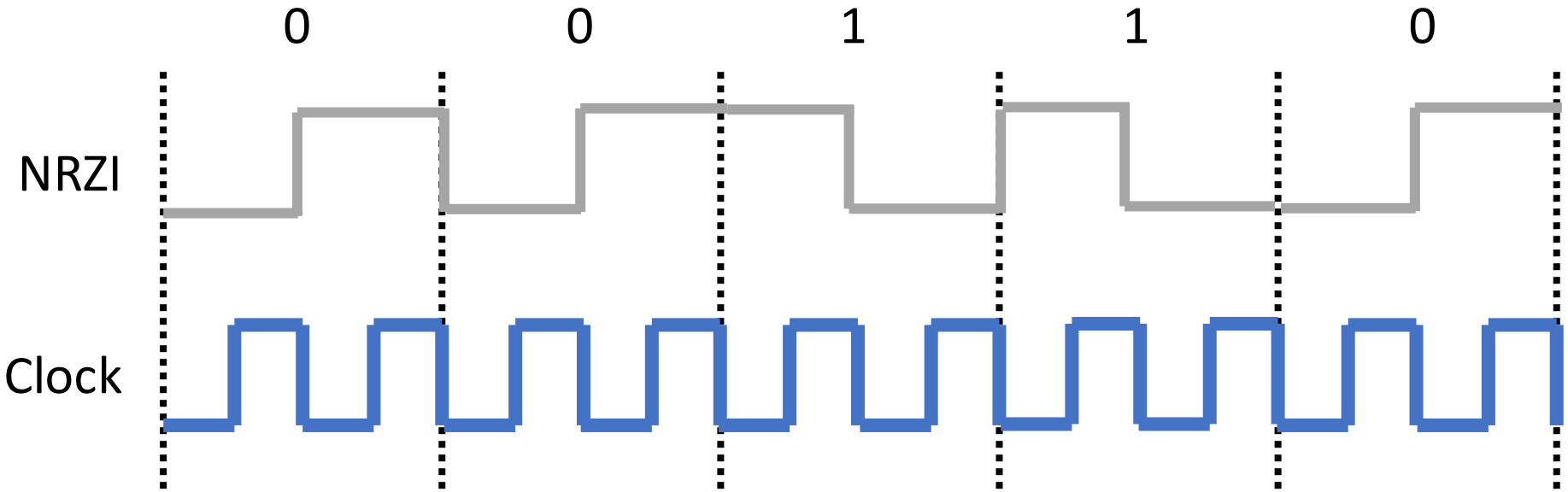
- We have two discrete signals, high and low, to encode 1 and 0
- Transmission is synchronous, i.e. there is a clock that controls signal sampling



- Amplitude and duration of signal must be significant

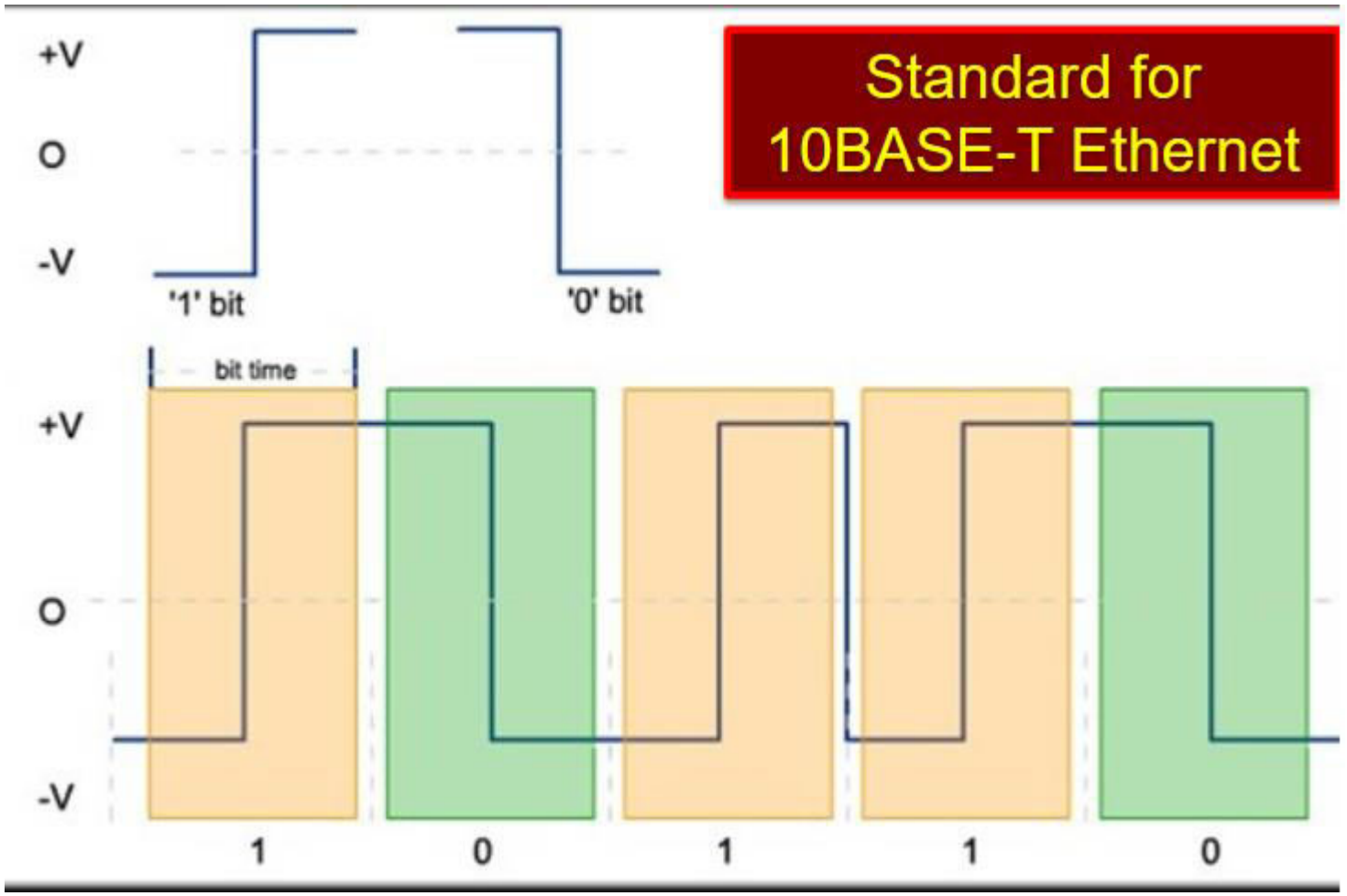
Manchester

- 1 → high-to-low, 0 → low-to-high



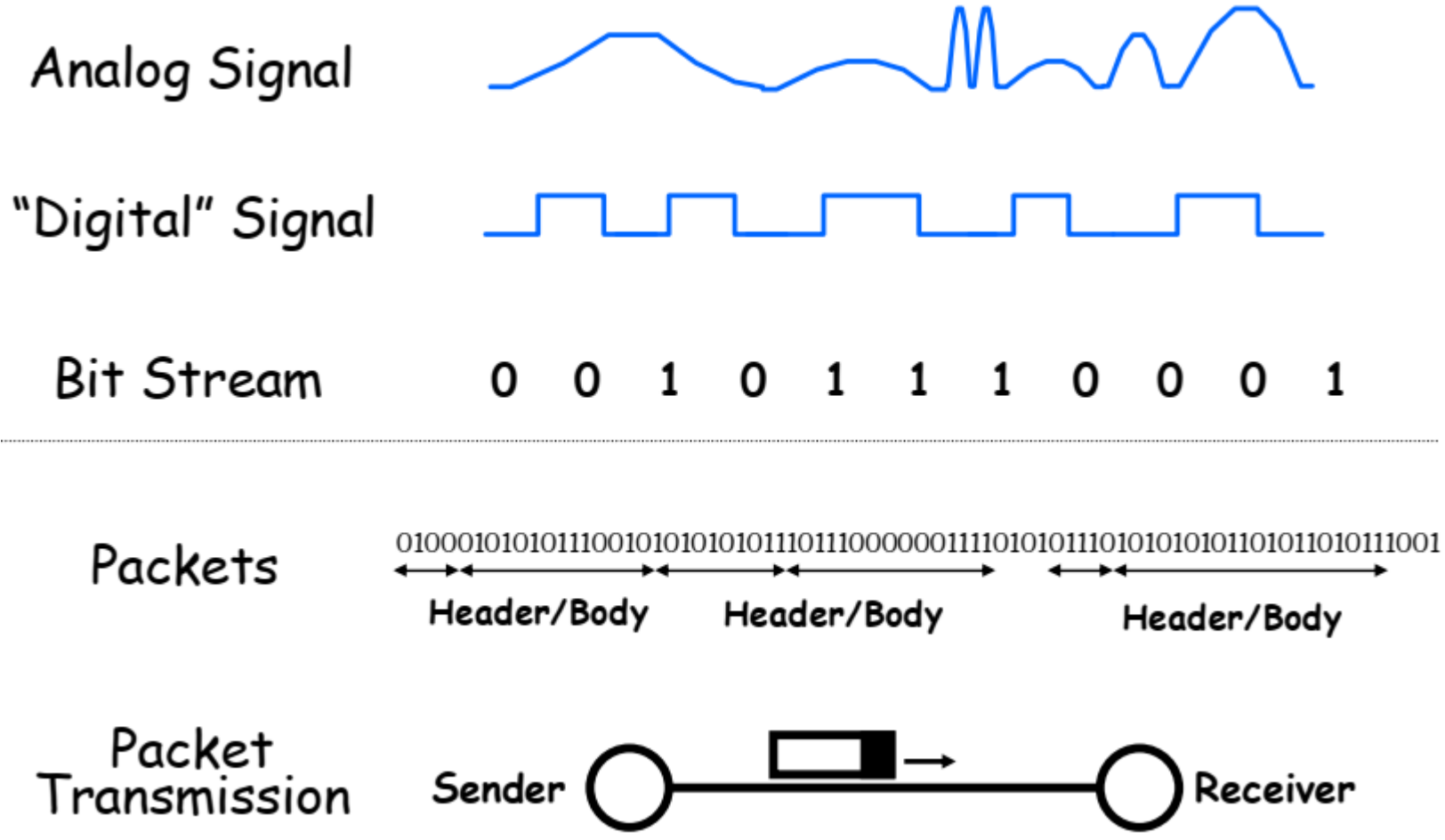
- Good: Solves clock skew (every bit is a transition)
- Bad: Halves throughput (two clock cycles per bit)

Manchester Encoding

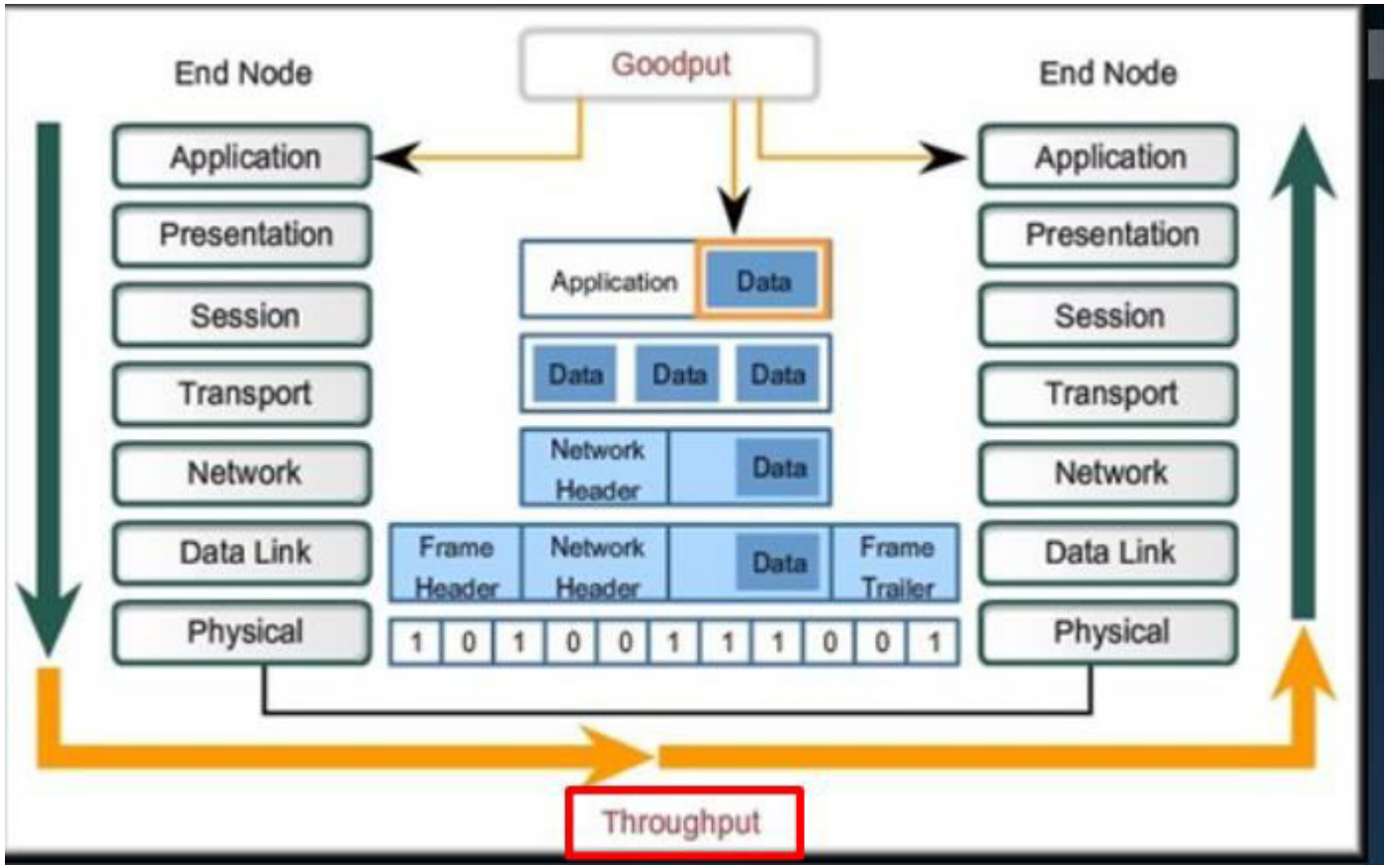


Manchester Encoding:
Uses the change in signal level in the middle of the bit time to represent the bits

Signals to Packets



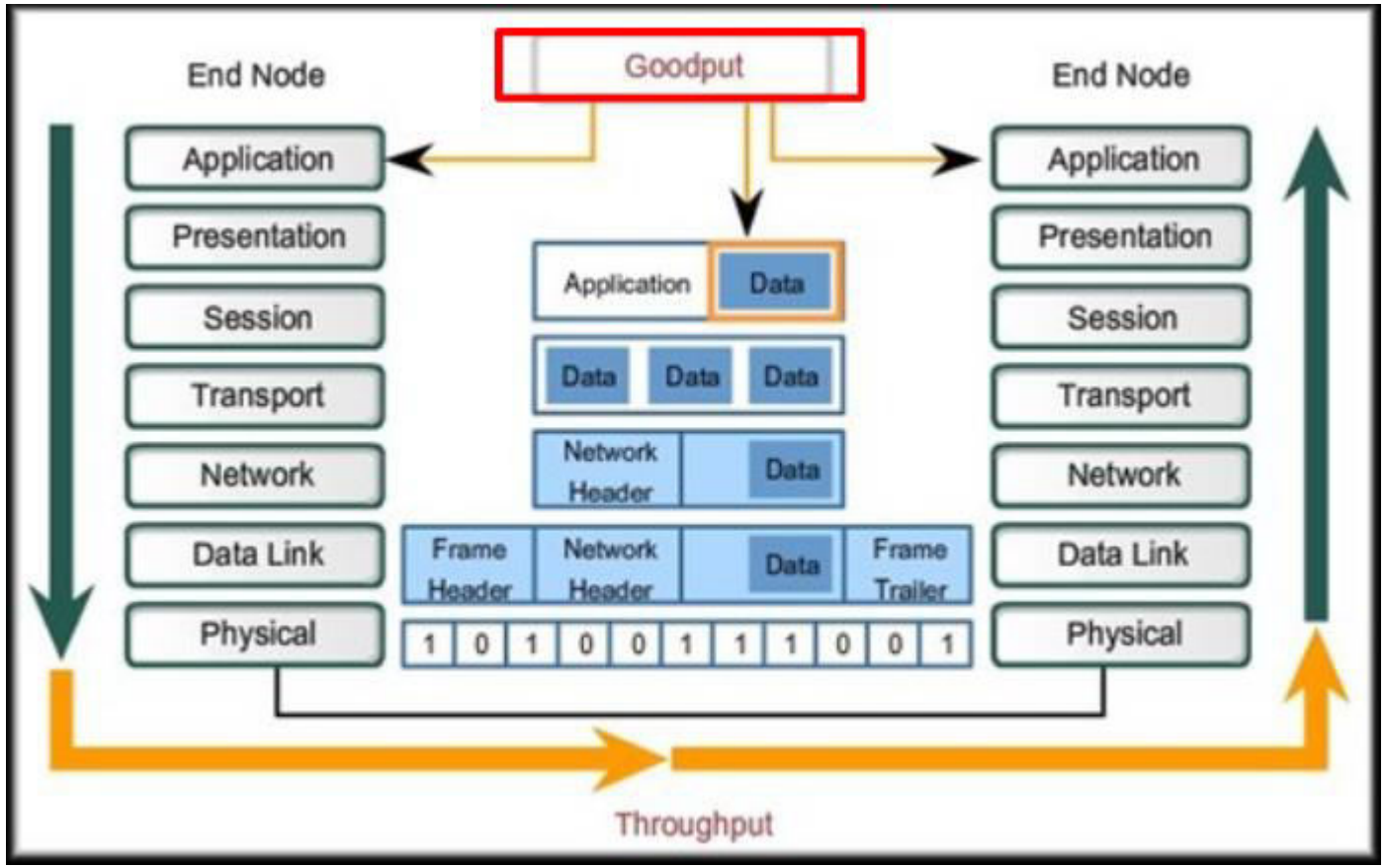
Data Carrying Capacity



Bandwidth(Theoretical)

- The capacity of a medium to carry data in a given amount of time
- Takes into account the physical properties of the medium and the signaling method

Data Carrying Capacity



Throughput(Practical):

- Transfer rate of data over the medium
- Factors that affect: Amount and type of traffic, number of devices

Goodput(Qualitative):

- Transfer rate of actual usable data bits
- Throughput less the data protocol overhead, error corrections and retransmissions

THANK YOU

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