

# Topic 5: Physical Layer

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## Class 8

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- Physical layer is the lowest level:
  - Understanding that the physical properties of various transmission mediums define the protocols we use
  - Bit by bit encoding of information into physical signal
- Ethernet (copper) cables:
  - Encoded as pulses of electricity
- Fiber cables:
  - Encoded as pulses of light
- Different physical properties so they may have different protocols
- Cabled connections
  - DLL protocol = 802.3 Ethernet
  - Point to point connections (exactly two devices)
    - \* Fiber
      - Full enclosed glass tubes with mirrored shielding
      - Photons bounce along the cable until it reaches a detector
      - Needs to be as straight as possible
    - \* Copper / Twisted Pair
      - Pair needed to complete the circuit
      - Two electrical magnetic field generated positive and negatively charged respectively
      - Field is powerful enough to corrupt data
      - Electromagnetic interference cancel each other out if they are close enough hence twisted
- Wireless connections

- DLL protocol = 802.11 WiFi
- Non-directional
  - \* All wireless devices go in every direction
  - \* Only matters if the device is within the range
  - \* Everyone in the recipient range of the device receives the data
- Encryption by default
  - \* Encryption by default has speed cost
- Encoded as radiowaves
- Channel Types
  - Simplex (unidirectionality)
  - Duplex (bidirectionality)
    - \* Full Duplex (send and receive at the same time)
    - \* Half Duplex (send or receive at any time only one receiver)
  - All cables can full duplex only restriction is cost
  - All wireless operate at half duplex
  - Modern devices operate at half duplex but extremely highspeed
    - \* Operates on the scale of picoseconds
  - Feels like full duplex
- Hardware
  - Each layer has a specific hardware devices
  - Network Hub (Physical Layer, Historical)
    - \* Solve the limitation of the cable
    - \* Central hub that ideally connects all devices
    - \* Act as an n-dimensional cables
    - \* No CPU or memory, just a bunch of logic gates (reducing cost)
    - \* Duplicates signal and sends the signal to all ports
    - \* Problem arises when two or more devices send at the same time data easily corrupted
      - This is called a collision domain
      - If there is more than one sender none of the messages get through
    - \* Cannot update the hub so you have to update all the devices connected
    - \* Carrier Sense Multiple Access
      - Solves collision domain problem by sharing the network

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```
function CSMA(message){
  while(receiving){
    wait();
  }
  send(message);
}
```

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- Downgrades connection to half duplex
- Limitation is assuming everyone upgrading at the same time
- Devices with CSMA and devices with no CSMA do not play well together
- Device without CSMA can still corrupt transmitted data

\* CSMA With Collision Detection

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```
function CSMA_CD (message){
  for(i = 0; i < message.length; i++){
    while(receiving){
      wait();
    }
    send(message[i]);
  }
}
```

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– Network Switch

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**Class 9**  
**02/27/2025**