

Physical Layer

Physical Connection : a physical connection to LAN must be established before any network communications

(1) Wired [Corporate Office]

(2) Wireless [Home]

* NIC connects a device to network

NIC = Network Interface Card

Different Connection → Different performance

Physical Layer: transports bits across the network media
↳ accepts a complete frame from layer 2
↳ encodes it as a series of signals

Characteristics

Standards : Layer 2 to 7 (OSI) implemented in software and governed by IETF

Layer 1+2 → implemented in hardware
governed by many organisations
(ISO, EIA/TIA, IEEE, ANSI etc)

3 functional areas : (1) Physical Components [hardware devices, media]
(2) Encoding
(3) Signaling

Encoding → converts the stream of bits into a format recognizable by the next device

Signaling → how the bit values "1" and "0" are represented on the physical medium

Bandwidth → the capacity at which a medium can carry data
Fundamental unit = bps (bits-per-second)

1 Kbps = 10^3 bps
 1 Mbps = 10^6 bps
 1 Gbps = 10^9 bps
 1 Tbps = 10^{12} bps

Terminology : Latency (1)
 Throughput (2)
 Goodput (3)

(1) Amount of time, including delays, for data to travel from one given point to another

(2) The measure of the transfer of bits across the media over a given period of time

(3) The measure of usable data transferred over a given period of time

Goodput = Throughput - Traffic overhead

Copper Cabling

Characteristics : (1) Inexpensive
 (2) Easy to install
 (3) low resistance to electric current flow

Limitations : (1) Attenuation
 (2) Susceptible to interference

(1) the longer the electrical signals have to travel, the weaker they get.

(2) Interference from 2 sources

- [Electromagnetic Interference EMI]
- [Radio Frequency Interference RFI]
- [Crosstalk]

Mitigation

To attenuation : strict adherence to cable length limits

To EMI, RFI : using metallic shielding and grouping

To crosstalk : twisting opposing circuit pair wires together

Types of Copper Cabling

(1) UTP Cable [Unshielded Twisted-pair]

(2) STP Cable [Shielded Twisted-pair]

(3) Coaxial Cable

UTP Cable : Most common networking media

Terminated with RJ-45 connectors

Interconnects hosts with intermediary network devices



Key Characteristics : (1) Outer Jacket → protects copper wires from physical damage
(2) Twisted Pairs → protect the signal from EMI, RFI
(3) Color-coded Plastic Insulation → electrically isolates wires identifies each pair

STP Cable : Better noise protection
More expensive
Harder to install
Same as UTP functions

Key Characteristics : (1) Outer Jacket → Physical damage protection
(2) Braided / Foil Shield → EMI / RFI protection
(3) Foil Shield → EMI / RFI protection
(4) Color-coded Plastic Insulation → Electrically isolates wires Identifies each pair

Coaxial Cable : (1) Outer Cable Jacket → Prevent minor physical damage
(2) Woven Copper Braid → Second wire in the circuit
Metallic Foil Shield for inner conductor
(3) Layer of flexible plastic insulation
(4) Copper conductor → Transmit the electronic signals