Internetworking Devices

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① LAN CARD

- Also known as NIC (Network Interface Card) / Ethernet Adapter, is a hardware component that allows computers to connect to their local Area Network using Ethernet Cables.
- Features → Speed (Supports diff. Ethernet speeds such as 10/1000 Mbps or 1Gbps
  → Compatibility (compatible with various network standards)
  → LED Indicators (shows activity & link status)

② TWISTED PAIR CABLES

- Used to connect to devices within local area networks (LAN's)
- consists of pairs of insulated copper wires twisted together in a specific pattern
- The twisting helps to reduce electromagnetic interference (EMI) from external sources and crosstalk btw adjacent pairs.
- Types : Unshielded Twisted Pair (UTP)
  Shielded Twisted Pair (STP)

③ FIBER OPTIC CABLES

- Type of high speed transmission medium used in telecommunications & computer networking to transmit data over long distances with high bandwidth & low latency
- Construction : consists of thin strands of glass or plastic fibres (optical fibres) bundled together in a protective jacket.
- Core & cladding : The core is the central part of the fiber through which light travels. Surrounded by a cladding layer that reflects light back into the core, preventing signal loss due to leakage.
- Types : Single-mode Fiber (SMF) - Single strand of optical fiber, small core, suitable for long distance transmission

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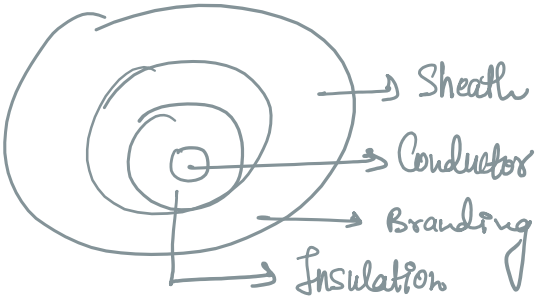
Multi-mode fiber (MMF) - multiple strands of optical fiber, large core, suitable for shorter distances within building or campuses, lower cost.

④ COAXIAL CABLE

- often referred to as Coax cable, is a type of electrical cable known for its use in telecommunications & broadband internet applications

- Construction:



⑤ ETHERNET CABLE

- Type of twisted pair cable used primarily for wired Ethernet networks.
- Types of Ethernet Cable : Category 5e [Cat5e] speed upto 1Gbps & frequencies upto 100MHz
  Category 6 [Cat6] speed upto 10Gbps over shorter distances
  Category 6a [Cat 6a] 10 Gbps upto longer distance
  Category 7 [Cat7] 10 Gbps & 40 GBps

⑥ USB CABLES

→ USB Type A
→ USB Type B
→ USB Mini
→ USB Micro
→ USB Type-C
→ Lightning Connector

⑦ HDMI Cables

- HDMI (High Multi-media Interface) are used for transmitting high-audio & video

- HDMI (High Multi-media Interface) are used for transmitting high-audio & video signals bw devices such as TV's, monitors, projectors, Blu-ray players, gaming consoles & computers.
- Types : Standard HDMI connector (Type A) 19 Pins
  Mini HDMI connector (Type C) cameras, camrecorders, micro-devices
  Micro HDMI connector (Type D) smartphones, tablets & portable cameras

⑧ RJ 45 CONNECTOR

- Standardized physical interface used for connecting Ethernet Cables to network devices such as computers, routers, switches & NIC's
- Pin Configuration : 8 Pins
- Color Coding : uses specific color codes to match the wires inside the cable to the pins
- Latch Mechanism : Typically features a plastic latch or clip that secures the connector to the Ethernet port, preventing accidental disconnection.

⑨ ETHERNET PORTS

- Also known as Ethernet Jack or Ethernet Interface, refers to the physical socket on a computer, router, switch or other networking devices where Ethernet cable are inserted to establish a wired Ethernet connection.
- Functionality : Point of communication
  Support various Ethernet standards
- Compatibility : Cat5e, Cat6, Cat6a which support diff. data transmission speeds

⑩ VGA

- VGA (Video Graphics Array) is a type of analog video connector
- 15 Pin DE-15 connector, three rows of pins, trapezoidal shape

⑪ REPEATER

- Networking device used to extend the reach & enhance the strength of a network signal, especially in environments where the signal may weaken over long distances

over long distances
- Signal Regeneration
- Extending Range
- Physical Layer Device (OSI Model)
- Types : Analog Signal Repeaters
  Digital Signal Repeaters
- Applications : Ethernet Networks
  Fiber Optic Networks
  Wireless Networks
- Limitations : Bandwidth Limitation
  Interference

(12) IP ADDRESS

- ISP (Internet Service Provider) grants access & assigns IP Address. IP Add. doesn't travel & keeps changing.
- Two main versions : IPv4 (four sets of nos ranging 0-255 separated by periods)
  IPv6 (8 groups of 4 hexadecimals separated by colons)
- Classification : Public IP — Dynamic / Static
  Private IP (Not routable)
  Shared IP (multiple websites or servers to save costs)
  Dedicated IP (exclusively by one company or individual)

(13) MAC ADDRESS

- Also known as Physical Address, Hardware Address or Burned-in Address (BIA)
- Globally unique, hexadecimal format, 12 digits
- Operates on Data Link Layer (OSI)
- embedded in NIC
- ARP (Address Resolution Protocol) is used to map IP Address to MAC address
- Six octets, 8 bits each, first three octets OUI (Organisationally Unique Identifier), last three octets are NIC specific
- Types : Unicast MAC Address

Last three octets are NIC specific

- Types : Unicast MAC Address
  Broadcast MAC Address
  Multicast MAC Address
  Locally Administered MAC Address
  Universally Administered MAC Address
  Burned-In Address
  Virtual MAC Address

(14) BRIDGE

- Networking hardware component that connects & filters traffic btw two or more network segments, allowing them to function as one!
- Key Functions : Network Segmentation
  Traffic Filtering
  Address Learning
  Collision Domain Reduction
  Broadcast Domain Reduction
- Types of Bridges : Transparent Bridge
  Source Route Bridge (Token Ring Networks)
  Network Bridge
- Use Cases : Network Expansion
  Legacy System Integration
  Performance Improvement

(15) HUB

- Basic Networking Device used to connect multiple devices in a network.
- Layer 1 at OSI
- Central Connection Point
- Data Transmission
- No Intelligence
- Collision Domain
- Half Duplex Communication

- Types : Active Hub (costly)
  Passive Hub (cheaper)
  Intelligent Hub

(16) SWITCH

- Filters & forwards packets between LAN segments based on MAC addresses.
- equipped with multiple ports
- Link layer of OSI
- Error Checking
- Data Forwarding
- Communication Mode
- Bandwidth Allocation
- Transmission Modes
- Data Transfere
- Port Quality
- Data Packet Handling
- Connection Management
- Types : Unmanaged Switches (small network, no config.)
  Managed Switches (advanced features & config., large network)
  Smart Switches (mid, basic capabilities)
  Layer 2 Switches (using MAC add.)
  Layer 3 Switches (using IP add.)
  PoE (Power Over Ethernet) Switches
  Stackable Switches (stacked physically as single unit)
  Modular Switches
  Enterprise Switches (high performance)
  Data Center Switches (specialized designed for data center environments)

(17) ROUTER

- A router is a networking device that forwards data packets btw computer networks
- Connects one or more packet-switched networks or subnetworks
- Path Determination

- Connection of Ports
- Routing Tables — static / dynamic
- Types : Broadband Routers
  Wireless Routers
  Wired Routers
  Edge Routers (positioned at the edge of the network)
  Core Routers (data transfer within the core of the network)
  Virtual Routers (software)
  Portable Routers (private Wi-Fi)

(18) GATEWAYS

- Gateways are network devices that serve as a bridge btw diff. networks
- enable communication btw networks that operate under different protocols
- Protocol Converter
- Application Gateway (operates at Application Layer)
- Router Functionality (routing functions to direct data)
- Security Features (firewalls, encryption & authentication)
- Configuration & Management
- Types : Network Gateway (connects diff. networks LAN, MAN)
  Internet Gateway (private network to Internet)
  VoIP Gateway
  Cloud Gateway
  Application Gateway
- Benefits : Interoperability
  Data Translation
  Security
  Flexibility
- Examples : Connecting Legacy Systems
  Integrating Cloud Services
  Enabling Remote Access

(19) NAT-M

Enabling Remote Access

(19) MODEM

- MOdulator - DEModulator
- enables data exchange btw different Digital devices of analog communication signals
- Types : Dial-up Modem
  Cable Modem
  DSL Modem
  Fiber Optic Modem
  Cellular Modem
- Benefits : Data Conversion
  Speed
  Connectivity
  Versatility
- Example Use Cases : Home Internet Cases
  Remote Work
  Business Connectivity

(20) ACCESS POINT

- Allow wireless devices to connect to a wired network using Wifi or other wireless standards
- Act as central transmitter of receiver of wireless radio signals
- Components : Radio Transceiver, Ethernet Port, Power Supply, Antennas
- Types : Standalone (independent units)
  Controller-Based (managed centrally by LAN controller)
  Mesh
  Outdoor
- Wireless Standards
- Security (Encryption Protocols)
- Roaming
- Management (configuration & interfaces)
- Quality of Services (QoS)
- Guest Access (separate wireless network for guest users)

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- Future Trends : WiFi 6 & Beyond
  5G Integration